

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

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

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

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

or

Block B - Medical radiophysics

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

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

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

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

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

or

Block C - Mathematical modelling of systems

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

MATH-H510 **Risk-based methodologies for energy systems** | Pierre-Etienne LABEAU (Coordinator) and Pierre HENNEAUX
 (optional) 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] 📅 second 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

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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] 📅 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
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 <small>(optional)</small>	Sustainability : an interdisciplinary Approach Cathy MACHARIS (Coordinator) and Waldo Galle ⌚ 6 credits [lecture: 36h, practical work: 24h] 📅 academic year 🗨 English
ENVI-F405 <small>(optional)</small>	Climat: sciences et politiques Frank PATTYN (Coordinator) and Louise Knops ⌚ 5 credits [lecture: 40h] 📅 second term 🗨 French
ENVI-F452 <small>(optional)</small>	Environmental impact analysis and management Wouter ACHTEN (Coordinator) ⌚ 5 credits [lecture: 24h, practical work: 12h, project: 24h] 📅 first term 🗨 English/French
ENVI-F454 <small>(optional)</small>	Energie: Société et environnement Michel HUART (Coordinator) and Nadine MATTIELLI ⌚ 5 credits [lecture: 30h, practical work: 12h, project: 24h] 📅 first term 🗨 French
GEST-H501 <small>(optional)</small>	Logistics Engineering and Management Alassane Ballé NDIAYE (Coordinator) ⌚ 5 credits [lecture: 12h, tutorial classes: 36h] 📅 first term 🗨 English
GEST-H502 <small>(optional)</small>	Supply Chain Performance Analytics Alassane Ballé NDIAYE (Coordinator) ⌚ 5 credits [lecture: 12h, tutorial classes: 36h, personal assignments: 12h] 📅 second term 🗨 English
GEST-S101 <small>(optional)</small>	Comptabilité financière Gilles GEVERS (Coordinator) and Laurent GHEERAERT ⌚ 5 credits [lecture: 36h, tutorial classes: 8h] 📅 second term 🗨 French
GEST-S318 <small>(optional)</small>	Introduction to theoretical finance Laurent GHEERAERT (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨 English
GEST-S421 <small>(optional)</small>	Entrepreneurial ecosystems Judith BEHRENS (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨 English
GEST-S492 <small>(optional)</small>	Energy policy, sustainability & management Adel EL Gammal (Coordinator), Julien BLONDEAU and Michel HUART ⌚ 5 credits [lecture: 36h, seminars: 24h] 📅 first term 🗨 English
GEST-Y501 <small>(optional)</small>	Business Management and Entrepreneurship Marc GOLDCHSTEIN (Coordinator) ⌚ 3 credits [lecture: 33h] 📅 first term 🗨 English
LANG-H500 <small>(optional)</small>	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 <small>(optional)</small>	How To Make (almost) Any Experiment Using Digital Fabrication Denis TERWAGNE (Coordinator) ⌚ 5 credits [lecture: 24h, practical work: 24h] 📅 first term 🗨 French
PROJ-H421 <small>(optional)</small>	Projet polydaire: expériences didactiques innovantes pour le secondaire Simon-Pierre GORZA (Coordinator) ⌚ 5 credits [project: 150h] 📅 academic year 🗨 French

