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 parallel with this thesis, a minimum of one module and 23 credits of specialised lectures have to be chosen among the five specialised modules in quantum technologies, photonics, mathematical modeling of systems, nuclear engineering and medical radiophysics. 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, tutorial classes: 6h, practical work: 18h] 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: 32h, tutorial classes: 18h, seminars: 6h, project: 10h] 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: 30h, practical work: 12h, seminars: 6h, field trips: 20h] second term English

Module 484 - Applied mathematics - Block 1

MATH-H401 Numerical methods | Pierre-Etienne LABEAU
4 credits [lecture: 30h, tutorial classes: 18h] first term English

MATH-H410 Monte Carlo methods | Pierre-Etienne LABEAU (Coordinator)
3 credits [lecture: 24h, personal assignments: 12h] first term French

PHYS-H514 Reliability and safety | Pierre-Etienne LABEAU (Coordinator)
3 credits [lecture: 22h, tutorial classes: 14h] first term English

One course chosen from the following

PROJ-H403 (optional) Project in physics engineering
5 credits [project: 150h] academic year English

PROJ-H417 (optional) Projet coopération au développement / Development cooperation project | 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 5 following modules (14 ECTS)

Block A - Photonics

ELEC-H507 Photonic communication systems | Simon-Pierre GORZA (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] first term English

PHYS-H510 Nonlinear optics | Pascal KOCKAERT (Coordinator)
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
4 credits [lecture: 24h, tutorial classes: 24h] academic year English

Block B - Medical radiophysics

PHYS-H500 Radiation dosimetry | Nicolas PAULY (Coordinator)
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
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 HERNALSTEENS
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
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)
1 credit [lecture: 12h] second term French

Block C - Mathematical modelling of systems

ELEC-Y591 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 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 Mathematics and economic modelling | Thomas DEMUYNCK (Coordinator), Bram DE ROCK and Luca Paolo Merlino
5 credits [lecture: 36h, tutorial classes: 24h] first term English

Block D - Quantum applications

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

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

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

Block E - Advanced nuclear engineering

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

PHYS-H527 Advanced reactor multi-physics
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] second term French

PHYS-H528 Nuclear fuel cycles and reactor technologies
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] second term French

Elective courses - Block 2

PROJ-H418 - Hands-on-learning : project manager (5 credits)

EPB Masters course, 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.

9 credits of courses from the 4 orientations not chosen

Photonics, Medical Radiophysics, Mathematical modelling of systems, Advanced nuclear engineering, Quantum applications)

ELEC-H507 Photonic communication systems | Simon-Pierre GORZA (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] first term English

ELEC-Y591 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 Quantum information and computation | Ognyan Oreshkov (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h, practical work: 12h] second term English

MATH-H510 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 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 Advanced condensed matter physics and quantum many-body systems | Nathan GOLDMAN (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h] second term English

PHYS-H500 Radiation dosimetry | Nicolas PAULY (Coordinator)
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
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 HERNALSTEENS
3 credits [lecture: 12h, practical work: 12h, field trips: 24h] first term English

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

PHYS-H516 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 Legal and regulatory aspects of radiation protection | Thibault Vanaudenhove (Coordinator)
1 credit [lecture: 12h] second term French

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

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

Elective courses

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

Internship

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

Free elective courses

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, personal assignments: 100h] academic year English

ENVI-F405 (optional)
Climat: sciences et politiques | Frank PATTYN (Coordinator)
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-H509 (optional)
Ethique de l'ingénieur
3 credits [lecture: 12h, tutorial classes: 12h, practical work: 12h] second term French

GEST-S101 (optional)
Comptabilité financière | Laurent GHEERAERT (Coordinator) and Gilles GEVERS
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)
5 credits [tutorial classes: 48h, personal assignments: 12h] first and second terms English

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