



VRIJE  
UNIVERSITEIT  
BRUSSEL

Joint programme with



GHENT  
UNIVERSITY

**EUROPEAN MASTER  
OF SCIENCE IN  
PHOTONICS**

[www.vub.be/european-master-photonics](http://www.vub.be/european-master-photonics)

**120  
ECTS**



# WHY VUB?

## **VUB education shapes strong individuals, critical minds and world citizens**

Vrije Universiteit Brussel (VUB) offers high-quality English-taught programmes, supported by state-of-the-art research. Being a student at VUB means learning in an open atmosphere of tolerance and diversity, as well as growing into an independent and critical-thinking individual.

VUB is a comprehensive university that offers education on student-friendly campuses in the cosmopolitan city of Brussels. At VUB, lecturers and assistants are available and approachable to students. Faculty members are on hand to answer questions and teaching often takes place in small groups to ensure close interaction and hands-on experience.

VUB is a dynamic and modern university with almost two centuries of history. We welcome more than 15.000 students, 21% of which are international students from more than 120 different countries.

## **The root of our academic success**

Vrije Universiteit Brussel was founded on the principle of 'free inquiry' as formulated by the French mathematician and philosopher of science Henri Poincaré (1854-1912):

*"Thinking must never submit itself, neither to a dogma, nor to a party, nor to a passion, nor to an interest, nor to a preconceived idea, nor to anything whatsoever, except to the facts themselves, because for it to submit to anything else would be the end of its existence."*

Personal development, open-mindedness, a positive and critical attitude and a sense of responsibility are values that characterise everyone at our university: from professors and researchers to students and staff members. It lies at the root of our academic success.





## LIGHT YOUR FUTURE

Photonics is the science of the harnessing of light. Photonics encompasses the generation of light, the detection of light, the management of light through manipulation, and amplification, and most importantly, its utilisation for the benefit of mankind.

Pierre Aigrain, Paris, 1967

## KEY ENABLING TECHNOLOGY\*

There is no doubt that photonics will continue to be a critical Key Enabling Technology. Photonic technology itself is drastically evolving and better lasers and more highly sensitive detectors will appear on the scene. It will also likely evolve toward mega-photonics that deals with very high power or energy and nanophotonics that handles extremely small regions. In this way things will be accomplished that no one was able to do in the past. However, the real innovation will happen when photonics is linked with other key enabling technologies. By combining photonics with other technologies such as biology, advanced materials and artificial intelligence, we will be able to create technologies that will truly change the world.

Hugo Thienpont, Brussels, 2019

\* Photonics has been listed as one of Europe's Key Enabling Technologies (KETs) by the EC. Key Enabling Technologies (KETs) provide the basis for innovation in a range of products across all industrial sectors. They underpin the shift to a greener economy, are instrumental in modernising Europe's industrial base, and drive the development of entirely new industries. Their importance makes them a key element of European industrial policy.

KETs are a group of six technologies: micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies. Artificial Intelligence (AI) and Cyber Technologies were highly recommended to be introduced as new Key Enabling Technologies (KETs) for the upcoming European Commission Framework Programme 9.

They have applications in multiple industries and help tackle societal challenges. Countries and regions that fully exploit KETs will be at the forefront of creating advanced and sustainable economies.

# EUROPEAN MASTER OF SCIENCE IN PHOTONICS



## Bridging physics, engineering and photonics

The European Master of Science in Photonics is an English-taught two-year master programme (120 ECTS) that leads to a joint degree from Vrije Universiteit Brussel and Ghent University. We offer students a challenging engineering programme that combines core photonics courses with a whole range of photonics electives and multidisciplinary modules, e.g. Electronics and Information Technology, Physics and Materials, Business Engineering, Modelling, Measurement and Control, Life Sciences. This multidisciplinary approach combined with a strong international component has proven to boost the employment prospects of our graduates to a maximum in innovative industries and research domains such as biotechnology, health care, green energy, ICT and Industry 4.0.

*"Being a student at VUB opens doors to a wide range of opportunities to grow and excel in the field of photonics. The programme is designed to prepare you for an academic and professional career through internships, business seminars, student networks and mobility tracks. In particular, my internship in Finland has helped me develop my skill set, engage in new cultures and expand my international network. Furthermore, as a student I was involved in the activities of BEST (Board of European Students of Technology) where I learned how to interact and deal with companies, develop my soft skills and meet other technology students from all over the world."*

Ayman Morsy - Egypt  
1 Ma European MSc in Photonics

BACHELOR OR UNDERGRADUATE DEGREE*				
SEM 1	CORE PHOTONICS		ADVANCED PHOTONICS	SEMESTER
SEM 2	CORE PHOTONICS		ADVANCED PHOTONICS	COMPULSORY 56 ECTS
SUMMER BREAK	INTERNATIONAL RESEARCH/INDUSTRIAL INTERNSHIP (MIN. 10 WEEKS)			ADVANCED PHOTONICS 16 ECTS*
	INDUSTRIAL INTERNSHIP IN PHOTONICS (MIN. 5 WEEKS)			
SEM 3	ADVANCED PHOTONICS	MULTIDISCIPLINARY	RECENT TRENDS IN PHOTONICS	INTERNSHIP 10 ECTS/4 ECTS
SEM 4	MASTER THESIS			MULTIDISCIPLINARY ELECTIVE 18 ECTS*
GRADUATE EUROPEAN MASTER OF SCIENCE IN PHOTONICS (120 ECTS)				MASTER THESIS 30 ECTS
PHD PROGRAM		INDUSTRY		

\*or at least 12 ECTS combined with international internship (10 ECTS)

\* B.Sc. in Electrical engineering or in (Applied) Physics or an equivalent such as Materials Science to be directly admitted to the program. Check our website for all details.

CORE PHOTONICS	ECTS
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**Semester 1**

Optical Materials	6
Microphotonics	6
Lasers	4
Introduction to Business Economics	3
Photonics	4
Mathematics in Photonics	4

**Semester 2**

Laboratories in Photonics Research	6
Optical Communication Systems	6
Sensors and Microsystem Electronics	6
Physics of Semiconductor Technologies and Devices	4
Business Aspects of Photonics	3

**Semester 3**

Recent Trends in Photonics	4
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ADVANCED PHOTONICS	ECTS
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**Photonics Electives**

At least 12 and at most 16 ECTS to be chosen in master year 1/2

Optical Spectroscopy of Materials	4
Display Technology	4
Non-Linear Optics	4
High Speed Photonic Components	4
Biophotonics	4
Optical Sensors	4
Design of Refractive and Diffractive Optical Imaging Systems	4
Optical Design with Ray-tracing Software: Laboratory	4
Introduction to Quantum Physics for Electrical Engineering	4
Technological Processes for Photonics and Electronics: Laboratory	4
Photovoltaic Energy Conversion	4
Quantum Optics	4
Micro- and Nanophotonic Semiconductor Devices	4
Photonic Integrated Circuits	4

**Internships**

Internship in Photonics	4
International Internship in Photonics	10

ECTS (European Credit Transfer System):  
1 credit represents 25-30 hours of study activity.

The programme is subject to change. For detailed information about the courses and the programme:  
[www.vub.be/european-master-photonics](http://www.vub.be/european-master-photonics)

The final multidisciplinary programme is subject to approval by the Programme Board.

The most exciting future challenges will require the ability of working across different disciplines. Our students can follow a model track with mandatory and elective courses and further design the programme with one of the multidisciplinary Engineering Modules:

MULTIDISCIPLINARY	ECTS
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**Module Information and Communication Technology Systems**

Machine Learning and Big Data Processing	1
Computer Vision	4
Digital Communications	4
Wireless Communication Channels	4
Mobile and Wireless Networks	4
Image and Video Technology	3
Voice, Image, Coding, Media and Systems	6

**Module Physics and Materials**

Computational Physics	4
Quantum Field Theory	6
General Relativity	6
Physics and Chemistry of Nanostructures	6
Surface physics and surface characterization	3

**Module Modeling, Measuring and Control**

Optimization-based Control Design	5
Fault Detection and Isolation in Industrial Processes	3
Measuring and Modelling of Nonlinear Systems	3
Identification of Dynamical Systems	4
High-frequency Electronics and Antennas	6
Advanced Measurement and Identification	4

**Module Business Engineering**

Innovation Management	3
Marketing	6
Technological Business Development Project	3
Technological Business Development Project	6
Trade Mission	6
IP Management and Technology Transfer (Chaire Solvay)	5
Operations and Logistic Management	6

**Module Life Sciences**

Modelling of Physiological Systems	2
From Genome to Organism	6
Quantitative Cell Biology	3
Biomaterials	6
Biomechanics	6
Biomedical Imaging	3

# JOIN A STRONG RESEARCH NETWORK

## GROUNDBREAKING RESEARCH IN PHOTONICS

At VUB B-PHOT Brussels Photonics you will be trained by professors and professionals with an impressive track record in optics and photonics. This leading research group has over 30 years of experience in photonics research and its applications. A team of 60 researchers will submerge you in the fascinating world of light and teach you how Photonics affects all fields of endeavor: internet, smartphone, road traffic, aviation, food safety, disease diagnosis,...

Photonics is smart, it is part of our everyday lives and it has truly become a game-changer in industry and society.

At VUB B-PHOT we are the storytellers of light, not only by teaching the next generation and doing fundamental research in the Photonics Innovation Center but also by leading large-scale European projects and working closely with research centers and companies from all over the world to share, validate and implement our knowledge to better the world in a spectacular way.

## THE WORLD IS AT YOUR FEET

By studying photonics at VUB, in the beating heart of Europe, you will not only join a team of international students, researchers and lecturers.

You will also have the opportunity to study courses and/or do your master dissertation at one of our preferred partner universities, get real-life work experience by doing an international internship in a research institute or photonics company, attend conferences and visit major photonics companies.



*"The partner institution I chose, UPC, offers a great programme in telecommunications, in wireless optical communications and optical fiber, around which I would like to write my master's thesis.*

*Building on my experience as an international student from Iran, Erasmus+ offers a great opportunity to continue to broaden my horizon, develop my international experiences in education and meet new people."*

Pooria Iranian - Iran  
1 Ma European MSc in Photonics



*"The European MSc in Photonics equips you with an exquisite skillset, combining theoretical expertise with hands-on training in fully equipped world class research labs, offering a very valuable focus on industrial applications and valorisations.*

*In addition, international experience in the heart of Europe exposes you to a variety of cultures and opportunities to interact, learn and exchange in a friendly environment. The programme has at times been demanding and challenging, but certainly a highly enjoyable and rewarding experience I would strongly recommend!"*

Martin Skënderas - Albania  
2 Ma European MSc in Photonics



45 students in master year 1



Full English-taught programme



Joint degree from 2 universities



*"There has been light from the beginning. But we hardly measure the importance of light in our daily lives. Light is nowadays used for everything from internet cables to low cost light sources. However, this is just a beginning and we have many more exciting discoveries to make and applications to invent. I have understood this as I was studying photonics at VUB in the framework of European MSc (Erasmus Mundus, at that time). As students, we were exposed to interdisciplinary curricula on how light aids in and interacts with various other disciplines. We also witnessed a number of close collaborations with various industries, which gave us a unique opportunity to understand how photonic inventions make their way to market. The gained knowledge helped and steered me tremendously as I continued on developing photonic sensors for biosystems during my PhD at EPFL and now inventing optoelectronic micromachines as a PostDoc at MIT. I can't stress enough how innovative and visionary this program is."*

Dr. Volodymyr Koman  
Alumnus European MSc in Photonics  
Strano Research Group  
Massachusetts Institute of Technology

## ADMISSION CRITERIA

Admission is based on the review of each application: proof of meeting academic and language requirements, personal motivation, etc.

### LANGUAGE REQUIREMENTS

Prospective students can provide proof of sufficient knowledge of English as language of instruction by meeting one of the following criteria:

- having successfully completed one of the following language proficiency tests:
  - TOEFL: minimum level: 213 for the computer-based test (CBT); 87 for the internet-based test (IBT); 570 for paper-based test
  - IELTS: minimum level academic module 6.5
  - Cambridge-ESOL English First (FCE)
  - ITACE

To start your application now: [www.vub.be/en/apply](http://www.vub.be/en/apply)

### ADMISSION

The programme is open to applicants with a bachelor or master's degree in Electrical Engineering, (Applied) Physics and Materials Sciences.

Students in their last year of such programmes will also be considered. Applicants holding a bachelor or master degree in another equivalent field of engineering are welcome to join the programme through a personalised preparatory programme. This preparatory programme can be combined with the master programme or in 3rd bachelor.

For more information on requirements:

[www.vub.be/european-master-photonics](http://www.vub.be/european-master-photonics)

### Application deadline

Application are open from 1 October onwards. Prospective students are advised to apply as soon as possible, even if they have not yet obtained their degree.

### Tuition fees

You can find the actual fees on: [www.vub.be/en/tuition-fees](http://www.vub.be/en/tuition-fees)

### VUB Scholarships

Every year the Vrije Universiteit Brussel awards 5 scholarships to students of the European MSc in Photonics based on technical knowledge, excellence and motivation. Each scholarship amounts to € 10.000/academic year covering the cost of living and studying in Brussels.

### More Grants

The master's programme board awards several grants on a competitive basis among all accepted students, such as EMSP Excellence Grant, Erasmus+ credit mobility scholarships, EMA2-partnerships Grants.

### EUR-ACE engineering master

A graduate of this programme may define himself/herself 'EUR-ACE® Master'. EUR-ACE® is the European quality label for engineering degree programmes which have been accredited in accordance with the EUR-ACE® Framework Standards and Guidelines. The European Master of Science in Photonics was accredited by the accreditation agencies CTI and NVAO.



### Contact

[www.vub.be/european-master-photonics](http://www.vub.be/european-master-photonics)