EUROPEAN UNIVERSITY

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EUROPEAN UNIVERSITY FOR CUSTOMISED EDUCATION

STUDY GUIDE
Excellence Programme

BIOINSPIRED CHEMISTRY

Organised by

University of MONS

1. IDENTIFYING DATA.	
Course Name.	Master in Bioinspired Chemistry (Master 2 level)
Coordinating University.	University of MONS
Partner Universities Involved.	Poznan University of Technology (PUT), University of Catania (UNICT), University of Mons (UMONS), University of Peloponnese (UoP), University of Cantabria (UC), University Mohammed VI Polytechnic (UM6P)
Course Field(s).	Bioinspired systems, Biomimetics, Supramolecular Chemistry, Biomaterials, Biophysical chemistry, Functional Macromolecules, Nanomedicine, Biointerfaces, Sustainable & Environmental Chemistry, Smart Materials, Clean Energy, Catalysis
ISCED Code.	ISCED 0531 (Master level)
SDG.	Goal 3 Good Health and Well-Being Goal 7 Affordable and Clean Energy Goal 9 Industry, Innovation and Infrastructures Goal 10 Reduced Inequalities within and among countries Goal 12 Responsible Production and Consumption Goal 13 Climate Action
Mode of Delivery	On-campus, Hybrid, Summer School, Labs, Seminars, Research internship
Language of Instruction.	English 100%
EUNICE Key Competencies	[Indicate the Key Competencies offered by the course.] • Green – strongly • Orange - moderately • Red – partially • Blank cell - not at all

Problem solving	
Teamworking	
Communication	
Self-management	

	Cognitive flexibility	
	Digital competence	
	Technical competence	
	Global intercultural competence	

· Number of ECTS credits allocated.	**Path A**: 60 ECTS: Full programme including summer school, shared courses and Master thesis abroad **Path B:** 36 ECTS: Summer school and Master thesis abroad
· Mode of Delivery.	On-campus, Hybrid, Summer School, Labs, Seminars, Research internship
· Course Dates.	September 2026 – August 2027
· Precise Schedule of the Lectures.	[Indicate duration and periodicity of the course lectures and other synchronously delivered course activities]
· Key Words.	Bioinspiration, Sustainable, Chemistry

· Prerequisites and co-requisites.	Enrolled in a Master 1 (1st year of Master) and background in Chemistry/Physics/Biology/Engineering/ Pharmacy
· Number of EUNICE students that can attend the Course.	From 10 to 30 students
· Number of EUNICE students that can attend the course per institution	Path A: 5 students for institution [min 10-max 20] Path B: 5 students for institution [min 15-max 30]

2. CONTACT DETAILS.	
· Department.	University of Mons, Poznan University of Technology, University of Catania, University of Peloponnese, University of Cantabria, University Mohammed VI Polytechnic
· Name of Lecturer.	Prof. Philippe Dubois, Recteur de l'Université de Mons, UMONS, Belgique
· E-mail.	philippe.dubois@umons.ac.be

3. COURSE CONTENT.

The Master Program in Bioinspired Chemistry explores and takes inspiration from structures and assemblies found in Nature to design new approaches for facing challenges in health, energy, information technologies, materials, and catalysis. This emerging area implies a multidisciplinary approach gathering domains of (bio)chemistry, (bio)materials, supramolecular systems, macromolecules, nanomedicine, self-organization, and nanosciences. This master's degree aims at
offering an educational background connecting the laboratory environment and the living world to
mimic complex strategies elaborated by Nature, which represents infinite scientific and technological challenges. These challenges will be taken up through bioinspiration and biomimicry
angles keeping in mind environmental awareness and ethics, while responding to ecological and sustainable transition challenges. This program offers a unique opportunity to explore and get inspired by living systems to develop cutting-edge technologies.

Programme Structure: full-fledged to be implemented when all legalities, operations, funding, accreditation, binding, and commitment are in place by EUNICE (Path A, 60 ECTS) or partial programme (Path B, 36 ECTS)

Path A total of 60 credits (on-line and face to face) with:

- 6 credits for the autumn Summer school

A one-week summer/autumn school will be organized at the beginning of the academic year (September) during which basic seminars in the field of Bioinspired Chemistry and research activities
that are developed in each University will be presented. Students will also be involved in a project
based on existing literature. At the end of the school, students will be able to choose the topic of
their Master thesis and to workwork on the related SOTA.

- 24 credits of elective courses

To choose in a EUNICE list constituted by courses from each partner University (see Section 4). Students can customize their course program by choosing 24 credits from this list (at least 12 credits
in their home University). Courses will be given during the period from September to January, either face-to-face (local courses) or online (partners courses).

- 30 credits for the Master Thesis

The Master thesis involves research that must be conducted in one of the partner Universities, with
a physical mobility of 3 to 5 months during the period February-June. The research topic should be

chosen in agreement between the home institution and the host University.

Path B total of 36 ECTS (online and face to face) with:
This pathway does not require the completion of shared courses, but includes participation in the International Summer School, which will take place in Catania from 7 to 11 September 2026, as well as traineeship mobility (Erasmus+) aimed at carrying out the thesis.

Summer School: The Summer School will be held in Catania from the 7th to 11th of September 2026,

during which students will have the opportunity to engage with faculty members from the laboratories and
partner universities where they may carry out their thesis traineeship.
The available positions related to the EP Bioinspired Chemistry programme for the academic year 2026–202 7 will be published in the EUNICE Internships and Research portal at the following link: https://internships.eunice-university.eu/en/research-theses?field_country_value=All&field_level_value=All&field_fields_of_study_target_id=All&field_erc_value=All&field_start_date_value_1=&field_financial_support_for_the_value=All&field_keywords_target_id=&field_name_supervisor_value=&field_eunice_related_programme_value=ep_bioinspired_chemistry_2026_27

Find below a draft programme of the Summer School *"Biomimetic Chemistry and Green Nanotechnologies"* (Sept 7-11, 2026)

	Sunday 06/09	Monday 07/09	Tuesday 08/09	Wednesday 09/09	Thursday 10/09	Friday 11/09
9:00 - 10:00		Welcome and registration	*Panel 3 "..."* *Speaker:*	Free time	*Panel 12 "..."* *Speaker:*	Student presentations (Group 1)
10:00 - 11:00		Opening session Speaker:	*Panel 4 "..."* *Speaker:*	*Panel 8 "..."* *Speaker:*	*Panel 13 "..."* *Speaker:*	Student presentations (Group 2)
11:00 - 11:30		Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
11:30 - 12:30		*Panel 1 "..."* *Speaker:*	*Panel 5 "..."* *Speaker:*	*Panel 9 "..."* *Speaker:*	*Panel 14 "..."* *Speaker:*	Student presentations (Group 3)
12:30 - 14:00		Lunch	Lunch	Lunch	Lunch	Lunch
14:00 - 15:00	ARRIVAL	*Panel 2 "..."* *Speaker:*	*Panel 6 "..."* *Speaker:*	*Panel 10 "..."* *Speaker:*	Factory visit	Closing remarks
15:00 - 16:00		Round table with students	*Panel 7 "..."* *Speaker:*	*Panel 11 "..."* *Speaker:*		DEPARTURE
16:00 - 17:00		Student working time	Student working time	Catania walking tour		
17:00 - 18:00		Free evening	Free evening			
18:00 - 19:30				Social dinner		
19:30 - 22:30						

4. LEARNING OUTCOMES.

The Learning Outcomes on each course will be developed on individual Course Study Guides. The learning outcomes will include a methodology process with selected courses in each item, to guarantee success for targeted Competence-based learning. Experimental courses in labs as well as industrial internships and/or visits in industries including a deep exchange with specialists in bio technologies and bio-materials, will be developed to strengthen the bridge between academic knowledge and the private sector, making conditions for potential increase of capacity building. Exhibition, technology survey with oral defense for evaluation will allow graduate students to valorise their outcomes in a specific field.
The sector of bioinspired chemistry has a potential leading role to play in addressing some of the most important challenges that humanity must solve, such as developing new biomaterials for health, drug-delivery systems, adaptive materials with life-like properties, improved catalysts that function in water, high-density information storage systems, etc., while responding to ecological and sustainable transition challenges. By working in this field, graduates can play a relevant role in social transformation, while developing professionally.

5. JOB, OCCUPATION.

Graduates of the Excellence Programme in Bioinspired Chemistry will find employment in both the private and public sectors. They will act as experts or project managers/officers in private companies from different sectors, such as: R&D engineers, biomaterials, pharmaceutics, nanomedicine, catalysis, etc. They will also be ready to be employed in the public sector and be ideally prepared for starting PhD studies in the field of bioinspired chemistry and biomaterials after graduation, ideally within the EUNICE consortium.

6. PROGRAMME ORGANISATION		
INSTITUTION	COURSE	ECTS
UNICT	Advanced biochemistry by Vincenzo Giuseppe NICOLETTI The course provides students with in-depth knowledge of particularly interesting biochemical processes relating to various physio-pathological aspects. For example: bioenergetic management from bacteria to higher eukaryotes; glycemic control in humans and management of energy reserves; advanced glycation end products; molecular basis of protein conformational disorders; angiogenesis in tumors and neurodegenerative diseases; metabolism of certain amino acids; fundamentals of nutritional biochemistry.	6
UNICT	Nanomedicine and Theranostics by Cristina SATRIANO The course provide students the necessary tools for understanding various types of interactions that occur at the nano-biointerfaces, including that between cells and tissues and their natural or artificial	6

	surroundings, the thermodynamic and kinetic aspects of biomolecule-biomaterial interface, with insights into the fundamental role of water at biointerfaces, biomimetic and bioinspired systems (e.g., supported lipid bilayers, nanozymes). The influence of mechanical (viscoelasticity), physical (topography) and chemical (surface free energy, composition and structure) properties of surfaces on cellular processes such as adhesion, differentiation and proliferation and how these can be modulated, particularly at the nanoscale, to obtain 'smart' systems that respond to environmental conditions (chemical, physical and/or biological stimulus) for application in nanomedicine and theranostics (therapy+diagnosis/imaging).	
UNICT	Principles of biological physical chemistry by Carmelo LA ROSA Recalls of thermodynamics, kinetics and spectroscopy, the structure of liquid water, hydrophobic effect, and liquid crystals. Differential Scanning Calorimetry. Circular Dichroism. Statistical Thermodynamics. Molecular Dynamics. Solid-state NMR. ESR. X-ray diffraction. Fourier Transform. Biological membranes. Proteins. Nucleic acids.	6
UMONS	Bioinspired supramolecular chemistry by Mathieu SURIN, Julien DE WINTER and Pascal GERBAUX The objective of this course is to initiate the students to the field of Bioinspired Chemistry. We will explore and be inspired from living organisms, biomolecular structures and natural processes (e.g. self-organization, cooperativity, biomineralization), in order to design new approaches of chemistry to be applied to the domains energy, catalysis, health, (bio)materials, and information technologies. The course is divided in 3 parts: I. Biomimicry and Bioinspiration Examples of bioinspired structures and materials Principles of recognition, self-assembly, self-organisation, cooperativity DNA-inspired structures, Peptide-inspired structures, molecular receptors, and molecular machines II. Analytical methods for biomolecular systems III. Applications: Biomineralization, Supramolecular Polymers, Artificial Photosynthesis, Artificial Enzymes	4
UMONS	Physical chemistry of life sciences by Sylvain GABRIELE Introduction to the basic concepts of cell-substrate interactions, a desc ription of the cytoskeletal components and molecular motors, Concepts of cell mechanics and tensegrity, and the main experimental techniques for probing cell forces and surface micropatterning.	4
UMONS	Biomacromolecular engineering – Part I by Rosica MINCHEVA Introduction to biomaterials describing each polymer (synthetic or natural) in its chemistry and application (with notions on definitions and legislation), and to designing biomaterials as nanocarriers (micelles,	4

	polymersomes and LbL) or hydrogels (from definition to challenges).	
UMONS	Biomacromolecular engineering – Part II by Sylvain GABRIELE Description of recent developments in advanced hydrogels (PEG, PAAm, GelMA, etc.) and cutting-edge biomaterials for probing cellular responses to physicochemical modifications of the cell microenvironment (rigidity, viscoelasticity, cell-ligand density, etc.).	4
PUT	**Technology of special purpose materials and nanomaterials (lecture 30 h) by Katarzyna SZCZEŚNIAK** Knowledge related to structure, method of preparation and unique properties of materials, biomaterials and nanomaterials. Knowledge related to the properties and latest technologies of advanced materials nanomaterials and biomaterials. Definitions and types of materials with special properties. Special-purpose materials that are used in electronics, aerospace, printing, aerospace, medicine, classical and digital photography. Technology of materials used in photolithography. Resist polymer using photocrosslinking reactions, photodegradation and transformation of functional groups. Negative and positive photoresists. The application of polymer resists. Technology of integrated circuits and printed circuit boards. Self-organizing materials and their application in the preparation of thin films and liquid crystal displays. Technology of materials used in optoelectronics. Technologies of thermochromic and photochromic materials. Properties and application of thermochromic and photochromic materials. Electroluminescent and photoluminescent materials. Engineering intelligent materials. Intelligent gels. Technology of piezoelectric and pyroelectric materials. Types of piezoelectric materials. Application of piezoelectric and pyroelectric materials. The technology of liquid crystal materials. The liquid crystal compounds in the electric field. Liquid crystal thermography. Application of liquid crystal materials. Characteristics of materials used in medicine, dentistry and pharmacy. Types of biomaterials: metallic, ceramic, polymeric, carbon, composite. Criteria for the selection of materials in medicine. Biocompatibility of materials and the main criteria for the production of biomaterials. Technology of dental prostheses, tendons, joints, bones, blood vessels. Materials and methods for the preparation of endoprostheses. Preparation of contact lenses, artificial hearts, heart starters. Angioplasty. Materials for the manufacture of catheters and stents. Bioresorbable implants. Types of implants. Procedures existing during medicines technology, with particular emphasis on methods of improving the quality and effectiveness of medicines and their purity.	2

	Drug carriers. Preparation and application of polymer microcapsules and microspheres. Nanomaterials: types. Properties and application. Methodological basis of nanotechnology - the method of preparation, classification and characterization of nanostructures. Nanometals. Nanoceramics. Nanolayers. Nanofibers. Nanotubes. Nanocomposites. Powder nanomaterials. Methods for the preparation of nanomaterials. Preparation and types of nanostructures. Characterization of nanostructures.	
PUT	**Chemistry of biomolecules (Lecture 15 h) by Anna PARUS** To learn about the chemical structure of basic bio-molecules such as proteins, nucleic acids, carbohydrates, lipids and their derivatives. To learn about the reactivity of bio-molecules of great importance in the functioning of organisms. To lay the groundwork for a better understanding of the major subjects. Discussion of topics related to: 1. the structure and properties of proteins and amino acids, nucleic acids, enzymes, carbohydrates and their derivatives, as well as lipids and prenyl lipids and vitamins. 2. the reactivity of bio-molecules of importance in the functioning of organisms 3. methods of identifying selected chemical combinations and natural bio-molecules	1
PUT	**Biomaterials – (Lectures (15 h and laboratory (15 h) by Katarzyna ADAMSKA** The aim of the course is to provide students with the basic information about modern materials used in medical sciences. Issues related to ceramic, metallic, polymer, composite and natural biomaterials will be discussed. Students will gain knowledge related to the phenomena of biomaterial/environment interactions and factors influencing the biomaterial/tissue interactions. The aim of the course is to acquire knowledge in the field of practical application of modern materials used in orthopedics, cardiology, ophthalmology and dentistry. Additionally, the methods of producing selected groups of materials and the analysis of their properties will be discussed.	2
PUT	**Process safety in chemicals industry (Lecture 30 h) by Piotr MITKOWSKI** The aim of the course is to familiarize the student with the basic principles of safe operation of industrial equipment and fittings as well as qualitative methods and techniques for identifying industrial risk.	2

	Student is acquainted with the analysis of the causes and effects of selected accidents known from the petrochemical, food and related industries. As part of the course the following issues are discussed: 1. Basic terminology related to the occupational health and safety risk and industrial risk analysis. 2. Legal basis related to preparation of a safety report and location of an industrial plant (Environmental Protection Law together with relevant SEVESO III Directive), fire protection and guidelines for the use of equipment in potentially explosive areas (ATEX Directive, selected standards). 3. Rules for the location of industrial apparatuses and the location of chemical and related industries plants. 4. Methods supporting the identification and assessment of hazards such as: HAZOP, fault tree (FTA), event tree (ETA), FMEA. The methods are supported by examples. 5. Analyzes of selected accidents and failures in the chemical, petrochemical and related industries.	
PUT	**Selected aspects of chemical equilibrium (Project 15 h) by Magdalena REGEL-ROSOCKA** Extending knowledge of the fundamentals of chemical technology with issues related to chemical equilibrium, the impact of various parameters on the reaction equilibrium, and the rate of complex reactions. Classes include issues related to chemical equilibrium, the impact of various parameters on the change of equilibrium - on the example of a simulation of chemical reaction with distillation (reactive distillation) using a computer program RECTIFICATION. Classes also include calculation exercises in the field of chemical equlibrium and/or the rate of complex reactions.	1
UM6P	Bioinspired Chemical Strategies in Lignocellulosic Biorefinery by Youssef HABIBI This course will examine green chemistry and bioinspired chemistry, with a particular emphasis on the sustainable and renewable conversion of feedstock to useful materials. Students will learn about the structural and chemical attributes of important components of biomass (cellulose, hemicelluloses and lignin) and will have the foundation of green chemistry and sustainability metrics to relate to ultimate goals of circular bioeconomy. The course also covers concurrent self-assembly, supramolecular interactions, and (stimuli)responsive systems to enable material design and their applications.	5

UM6P	**Biomaterials by Muhammad SHOAIB** This course provides an in-depth overview of modern biomaterials used in medical applications. It emphasizes the understanding of the structure, properties, interactions, and applications of various nano, micro and macro size materials i.e. ceramics, metals, polymers, composites, and natural substances used in medical devices and implants. Students will explore how these materials interact with biological systems and the mechanisms governing their performance and biocompatibility. The course also covers fabrication techniques, surface modification methods, degradation behavior, and clinical applications in orthopedics, cardiology, ophthalmology, and dentistry. Case studies and current research developments are integrated to align theoretical knowledge with practical innovation.	5
UM6P	**Rational Drug Design by Imane BJIJ** This class will teach students the basic principles and approaches behind rational drug design. Emphasis will be placed on the molecular mechanisms of drug action, the discovery and design of new pharmaceuticals, and modern approaches for drug development and design, including computational methods. The goal is to prepare students to design new therapeutic agents based on the molecular understanding of disease mechanisms.	5
7. ASSESSMENT METHODS, CRITERIA AND PERIOD.		
[Provide information on how and when this course will be assessed, e.g. by means of a written or oral exam, a report, a presentation, a project, group work assessment.]	**· Students' assessment:** The evaluation of students will be course dependent. The modalities will be described in the related study guide at the beginning of each academic year, and be shared on the EUNICE Moodle platform. Internal rules shall be flexible considering the potential differences between assessment methods and timelines between IES universities. **The courses evaluation may comprise different components:** - An exam organized in-session or out-of-session by the University delivering the course, preferably in a synchronous mode (i.e. students following the course but staying at different Universities take the exam at the same time) or in asynchronous mode in case of agenda issues (this situation should be avoided as much as possible in order to prevent the increase of the burden for teachers). This exam shall be organized in hybrid mode (students taking the exam in F2F, others remotely): this	

	could be done by favouring oral exams, or by using Digital tools such as Quizizz, Kahoot, Wooclap, or similar ones. - A deliverable to be submitted by the students during the semester, or by the end of the semester: a report, an online presentation, etc. These deliverables could be related to lab sessions, projects, challenges, etc. The Summer School could be evaluated through a short-term on-site challenge, during which the students could work by teams. The evaluation would be based on a pitch presentation by each of the student teams, in front of a jury made of the staff of the IES universities participating to the Summer School. - Final grades will be sent to the coordinators on official forms signed by the lecturer no later than **two weeks** after the course ends or the exam is administered. Master Theses would be prepared at the University of the main supervisor and evaluated according to the University rules. Co-supervision between partner Universities is very welcome: one supervisor for the main supervising University and a co-supervisor from another partner University to boost collaborations. Given the differences between evaluation and teaching regulations in the respective Universities, a Pedagogical Workshop Preparation for the team members will be organized before the first intake of students. · Programme assessment: We will develop our assessment based on the learning objectives, outcomes of planned units, and programme Key Performance Indicators or KPIs (such as number of enrolled students from within the EU or outside the EU, number of applicants, number of scientific publications authored by our students, etc.). A board in charge of the internal quality monitoring of the programme will be established and will take care of these aspects. It will comprise representatives of each of the IES universities.	
OBSERVATIONS.		
	> Selection procedure The Master is open to all European students. However, priority will be given to students from partner Universities and from Universities of the EUNICE network. Candidates shall provide the following documents when applying to the programme: - a copy of the bachelor diploma/certificate - a proof of enrolment in a Master program of a European University - a transcript of records (ToR) of Bachelor level - an	

	English-Language certificate attesting their proficiency - a one-page (A4) motivation letter The access to the Master's program will be granted upon selection by a committee composed of teachers from partner Universities. The selection criteria will include an average grade of min. 70% in the Bachelor courses and proficiency in English (B2 level). The certification in English could be provided by the applicant's home University or based on an external evaluation such as TOEFL or Cambridge English Certificate. > Diploma After having successfully completed the Master in Bioinspired Chemistry, students will be granted Master with a diploma from their home University (i.e. where the student is enrolled), together with a certificate of success from this specific Excellence Program. > Mobility The program should be covered by an ERASMUS+ mobility agreement between the 10 EUNICE institutions to allow all EUNICE students to participate. For each student, a learning agreement will be generated following the ERASMUS+ rules allowing for a diploma in the home institution of the student. For path A, depending on the student enrolment two situations can appear: 1. The student is enrolled in one of the partner Universities: the EUNICE learning agreement should cover the 12 ECTS of elective courses that will be provided by the other institutions + 30 ECTS research internship. 2. The student is enrolled in a EUNICE university which is not partner of the program or is coming from outside the EUNICE network: the learning agreement should cover a 60 ECTS mobility in one of the partner universities. In that case, it will not be compulsory for the student to realize his/her Master thesis in another university since he /she will already be in a mobility program.	

8. BIBLIOGRAPHY AND TEACHING MATERIALS.

Provide a list of the (most important) literature that students are required or recommended to read.