JMPMB

ECTS Course Catalogue

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Introduction

Blue Biotechnology, or Marine Biotechnology, is a scientific-business activity that seeks the application of biotechnological advances methodologies to marine and aquatic environments. The European Blue Growth Strategy considers Blue Biotechnology as one of the five sectors with the greatest potential for growth and sustainable generation of highly qualified jobs. Universities and research institutions have a central role to play in promoting the 'Blue Economy' and 'Blue Growth' and to contribute to the skills and competences of the graduates who can work in a complex and challenging labour market.

The joint Master programme in Marine Biotechnology (JMPMB) will be delivered by **six partner universities** (Universidad Católica de Valencia (Spain) – Programme Coordinator University, La Rochelle Université (France), Agricultural University of Athens (Greece), Universitatea Tehnica de Constructii Bucuresti (Romania), Klaipėdos Universitetas (Lithuania), Sveučilište u Zadru (Croatia) in association with two Associated Partners (Waterford Institute of Technology (Ireland) and Universität Rostock (Germany) and in collaboration with a large number of stakeholders from companies and research centres. The six universities and partners joined together to merge their strengths and know-how in an interdisciplinary JMPMB and to offer the students to study at an international inter-campus European University.

The **mission** of the JMPMB is to equip the graduates with profound expertise and knowledge based on an interdisciplinary and holistic perspective, which will be the umbilical cord between modern biotechnology and the sustainable development of the marine environment. The programme will unite the graduate students under the same academic vision of the European University for Smart Urban Coastal Sustainability.

The main specific **learning objectives** of the JMPMB are:

- to acquire knowledge and technical skills regarding the relevant biochemical, molecular and systems biology approaches for the use of aquatic resources to develop new bioactive compounds,
- to understand the process of discovery and development of molecules derived and inspired by marine organisms and be able to set up an efficient pipeline to develop innovative marine natural products to meet the needs of consumers in various markets,
- to acquire skills related to the management of biotechnological innovation projects, the transfer of R&D and the protection of industrial and intellectual property in the marine biotechnology sector.

The students will benefit from access to international experts and state-of-the-art curricula. The EU-CONEXUS Associated Partners and networks include major commercial companies, research and education institutions, national and regional authorities, national and regional business development agencies and international organisations. Thus, global marine biotechnology challenges can be addressed for the benefit of the student. The JMPMB **thematic areas provide four tracks** (specialisations): (1) Innovative Bioproducts for Future; (2) Blue Biomass; (3) Marine Biorefinery; (4) Aquaculture Biotechnology.

Europe aims to be the largest biotechnology hub and the demand for talented individuals is increasing much higher than it was expected. In 2016, the Blue Economy provided 3.48 million jobs in the EU and the average wage increased by 14.2%. The EU-CONEXUS countries represent more than 50% of the EU`s Blue Jobs (European Commission, The EU Blue Economy Report. 2020;2019;2018). The JMPMB will prepare employable students for the current demands of the biotechnological sector. **JMPMB graduates** will work at different levels (project managers, researchers, lab managers, etc.) and in several types of organisations (from start-ups to big pharmaceutical companies) in various economic sectors such as cosmetics, food, agriculture, aquaculture or higher education.

Programme content

Title of the programme:	Joint Master programme in Marine Biotechnology (JMPMB)
Official length of the programme:	120 ECTS, 2-year studies
Mode of study:	Full-time studies
Qualification degree:	Master's Degree in Marine Biotechnology (or equivalent according to the national qualification of participating universities/countries)
Type of diploma:	Joint diploma
Field of study (ISCED):	05 Natural sciences, mathematics, and statistics
Tracks:	- Innovative Bioproducts for Future - Blue Biomass - Marine Biorefinery - Aquaculture Biotechnology
Language of studies:	English
Partner universities:	- Universidad Católica de Valencia, Spain (UCV) (Programme Coordinator University) - La Rochelle Université, France (LRUniv) - Agricultural University of Athens, Greece (AUA) - Universitatea Tehnica de Constructii Bucuresti, Romania (UTCB) - Klaipėdos Universitetas, Lithuania (KU) - Sveučilište u Zadru, Croatia (UNIZD)
Associated partner universities:	- Universität Rostock, Germany (Uni Rostock) - Waterford Institute of Technology, Ireland (WIT)
Access to:	third cycle (doctoral) studies and/or labour market

The joint Master programme in Marine Biotechnology is designed to ensure that students (1) get essential training in key subjects related to marine biotechnology, (2) have the opportunity to thematically specialise, (3) can tailor their study programme to their aspirations via individual professional practice (internship), individual research (Academic Research Integration) and thesis work. JMPMB includes a wide range of mobility opportunities but also ensures integration in a group and a network in the best possible circumstances. By using multiple teaching approaches, it offers an open learning environment to a multicultural group of students.

The JMPMB focuses on the applications of marine biotechnology to health, cosmetics, and agri-food sectors, as well as aquaculture or sustainable tourism leading the students through a pipeline including:

- biochemical and genomic prospecting tools for searching new molecules from aquatic resources;
- microorganisms, microalgae, and seaweed biomass production as feedstock of new compounds;
- biochemical and biotechnology tools for extraction and functionalisation of new compounds obtained from marine biomass for application to health, cosmetics, agri-food, and aquaculture sectors.

Year	Semester	Courses	Course	ECTS	University
Year 1	**Semester 1** Mobility 1	**Core courses**	Genomics, Proteomics and Metabolomics for Marine Biodiversity Prospecting	6 ECTS	**UCV -Spain-**
			Marine Microbiome and Metagenomics	6 ECTS	
			Culture Collections and Biobanks	8 ECTS	
			Marine Biodiversity for Marine Natural Products	4 ECTS	
			Blue Biotechnology Business and R&D Management I	6 ECTS	
	Semester 2 Mobility 2		Blue Biotechnology Business and R&D Management II	6 ECTS	**LRUniv -France-**
			Marine Natural Products: Classes, Biological Activity and Biosynthesis	6 ECTS	
			Chemical Libraries	6 ECTS	
			Screening of Bioactivity	6 ECTS	
	Mobility 3	Internship		6 ECTS	**France or any other country**
				60 ECTS	
Year 2	**Semester 3** Mobility 4	*Track 1* **Innovative Bioproducts for Future**	Academic Research Integration	14 ECTS	**AUA**, **LRUniv**, **UCV**
			Biological Profiling of Marine Natural Products	4 ECTS	
			Optimisation of Marine Natural Products	4 ECTS	
			Marine Natural Products for Health and Wellness and Food	4 ECTS	
			Advanced Characterisation Methods for Marine Natural Products Identification	4 ECTS	
		Track 2 **Blue Biomass**	Academic Research Integration	14 ECTS	**AUA**, **KU**, **UCV**
			Bioreactor Design and Management	4 ECTS	
			Microorganism Biomass and Metabolite Production	4 ECTS	
			Microalgal Biotechnology	4 ECTS	
			Seaweed Production	4 ECTS	
		Track 3 **Marine Biorefinery**	Academic Research Integration	14 ECTS	**AUA**, **LRUniv**, **UCV**, **UTCB**
			Design of Biorefinery Processes	4 ECTS	
			Marine Biomass Functional Ingredients Extraction	4 ECTS	
			Functionalisation of Marine-derived Biomaterials	4 ECTS	
			Marine Whole-cell Factories	4 ECTS	
		Track 4 **Aquaculture Biotechnology**	Academic Research Integration	14 ECTS	**AUA**, **KU**, **UCV**, **UNIZD**
			Aquaculture Systems and Seafood Processing	4 ECTS	
			Fish Nutrigenomics	4 ECTS	
			Health and Welfare in Aquaculture	4 ECTS	
			Advanced Breeding Programmes	4 ECTS	
	Semester 4 Mobility 5	Master thesis		30 ECTS	**AUA**, **KU**, **LRUniv**, **UCV**, **UNIZD**, **UTCB**, **other**
				60 ECTS	

The 120 ECTS joint Master programme consists of

- **Core courses** (54 ECTS) are taught throughout the 1st academic year in the areas of Marine Omics, Marine Biodiversity Prospecting, Blue Biotechnology Business and R&D Management and Bio-Chemistry of Marine Natural Products,
- **Internship** (6 ECTS; 8 weeks) is carried out at the end of the 2nd semester of the 1st academic year. The professional practice prepares students in a very practical way for future employment,
- **Optional courses** (taught virtually) of the chosen **track** (specialisation) (16 ECTS),
- Each track is completed with a course called **Academic Research Integration** (14 ECTS),
- **Master thesis** (30 ECTS).

The student enrolled in the programme has mandatory mobility among the universities of the Consortium with a full academic acknowledgement of the credits acquired.

The study organisation/mobility scheme:

	Host university
1st semester	UCV, Spain
2nd semester	LRUniv, France. Internship at the end of the 2nd semester may be carried at any company in any country
3rd semester	All Consortium universities according to the chosen track by the student in order to carry out his/her Academic Research Integration; the optional courses will be taught online
4th semester	Master thesis is carried out by the student in one of Partners,' Associated Partner universities or other higher education and/or research institution according to the chosen Master thesis topic.

During the two years of the programme, the student must study in at least two universities of the Consortium.

Learning outcomes

The programme has been designed as a research master, the graduates of which are expected to work at high proficiency, research oriented positions or to continue studies in PhD cycle.

KNOWLEDGE:

Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research.
Critical awareness of knowledge issues in a field and at the interface between different fields.

On successful completion of this programme, students should be able to demonstrate comprehensive and specialised knowledge and understanding of:

K1 - The wide biodiversity of marine genetic resources as a starting point to search for new bioactive compounds.	K2 - State-of-the-art techniques for extraction, identification and functionalisation of new molecules associated with bioactivities from marine origin feedstocks.	
K3 - Validation processes of brand-new marine bioproducts for their application to biomedicine, cosmetics and agri-food sectors.	K4 - Innovative procedures for the optimisation and improvement of functional compounds biosynthesis derived from marine organism cultures.	K5 - Environmental marine microbiome as a biotechnology approach to ecosystem management.
K6 - Advanced culturing techniques for a wide range of aquatic organisms suitable for biomass production.	K7 - Current strategies for funding, protection, transfer and commercialisation of R&D results in the biotechnological business environment.	

SKILLS:

Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.

On successful completion of this programme, students should be able to demonstrate comprehensive and specialised knowledge and understanding of:

S1 - Develop a workflow with highly specialized analytic equipment to discover new molecules with specific bioactivity.	S2 - Prepare in-vitro and in-vivo assays for validation of new bioproducts.	S3 - Propose cutting-edge biotechnological processes for biomass production from marine organisms.
S4 - Comprehensively assess patterns, trends and correlations from genomic data analysis for environmental applications.	S5 - Integrate avant-garde selective breeding programmes as a tool for a sustainable aquaculture.	S6 - Evaluate the relevance of laboratory results in order to choose next steps in bioproduct discovery roadmaps.
S7 - Extensively interpret entrepreneurial opportunities within biotechnology research to successfully launch new products and services in an emerging market.	S8 - Formulate ground-breaking proposals to make the emerging sector of Blue-biotech more visible and attractive for stakeholders to consider as a viable investment venue to further develop research focused on an industrial application.	
S9 - Efficiently integrate problem-solving skills and specialised knowledge and understanding from Blue-biotech for innovative solutions to current challenges concerning marine organisms.	S10 - Set up an efficient biotechnological pipeline to develop innovative marine natural products.	

RESPONSIBILITY AND AUTONOMY:

Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.

On successful completion of this programme, students should be able to:

R1 - Collaborate, manage, and lead multidisciplinary working groups to facilitate transnational and cross-border development of innovation and research projects to provide a coherent all-inclusive framework for the emerging sector of blue biotechnology.	R2 - Efficiently and skilfully manage a wide range of sophisticated laboratory equipment to carry out assigned tasks individually or in a collaborative working environment.
R3 - Create and manage entrepreneurial and innovative approaches to Blue-biotech to maximise its transformative impact on biomedicine, cosmetics and agri-food sectors.	R4 - Comply with the standards set by social responsibility and civic awareness to establish pioneering business models for a sustainable biotech industry.
R5 - Convincingly communicate scientific results in the emerging field of Blue-biotechnology to an audience of peers and non-peers by means of highly organised, coherent, and cohesive both written and oral discourses to contribute to the betterment of the field.	

Programme syllabi					
Core courses (compulsory)					
Thematic area	**Course**	**Language**	**Year**	**Semester**	**ECTS**
Marine Omics	Genomics, Proteomics and Metabolomics for Marine Biodiversity Prospecting	English	1	Autumn	6
	Marine Microbiome and Metagenomics	English	1	Autumn	6
Marine Biodiversity Prospecting	Culture Collections and Biobanks	English	1	Autumn	8
	Marine Biodiversity for Marine Natural Products	English	1	Autumn	4
Blue Biotechnology Business and R&D Management	Blue Biotechnology Business & R&D Management (I)	English	1	Autumn	6
	Blue Biotechnology Business & R&D Management (II)	English	1	Spring	6
Biochemistry of Marine Natural Products	Marine Natural Products: Classes, Biological Activity and Biosynthesis	English	1	Spring	6
	Chemical Libraries	English	1	Spring	6
	Screening of Bioactivity	English	1	Spring	6
Optional courses (according to the Track)					
Track 1. Innovative Bioproducts for Future					
Biological Profiling of Marine Natural Products		English	2	Autumn	4
Optimisation of Marine Natural Products		English	2	Autumn	4
Marine Natural Products for Health and Wellness and Food		English	2	Autumn	4
Advanced Characterisation Methods for Marine Natural Products Identification		English	2	Autumn	4
Track 2. Blue Biomass					
Bioreactor Design and Management		English	2	Autumn	4
Microorganism Biomass and Metabolite Production		English	2	Autumn	4
Microalgal Biotechnology		English	2	Autumn	4
Seaweed Production		English	2	Autumn	4
Track 3. Marine Biorefinery					
Design of Biorefinery Processes		English	2	Autumn	4
Marine Biomass Functional Ingredients Extraction		English	2	Autumn	4
Functionalisation of Marine-Derived Biomaterials		English	2	Autumn	4
Marine Whole-Cell Factories		English	2	Autumn	4
Track 4. Aquaculture Biotechnology					
Aquaculture Systems and Seafood Processing		English	2	Autumn	4
Fish Nutrigenomics		English	2	Autumn	4
Health and Welfare in Aquaculture		English	2	Autumn	4
Advanced Breeding Programmes		English	2	Autumn	4
Research and practice-based learning					
Internship		English	1	Spring	6
Academic Research Integration		English	2	Autumn	14
Master thesis		English	2	Spring	30

Tracks

The students can choose a specialisation from **four** tracks they would like to deepen their knowledge in during the 3rd semester:

1) Innovative Bioproducts for Future
2) Blue Biomass
3) Marine Biorefinery
4) Aquaculture Biotechnology

The students who choose the specialisation of **Innovative Bioproducts for Future** will focus on the validation of new marine bioproducts, following up all the procedures until the commercialisation of new therapeutic drugs, cosmetic ingredients and food additives. The students will be able to assist companies in the health, cosmetics and agri-food sectors to reach new markets and segments.

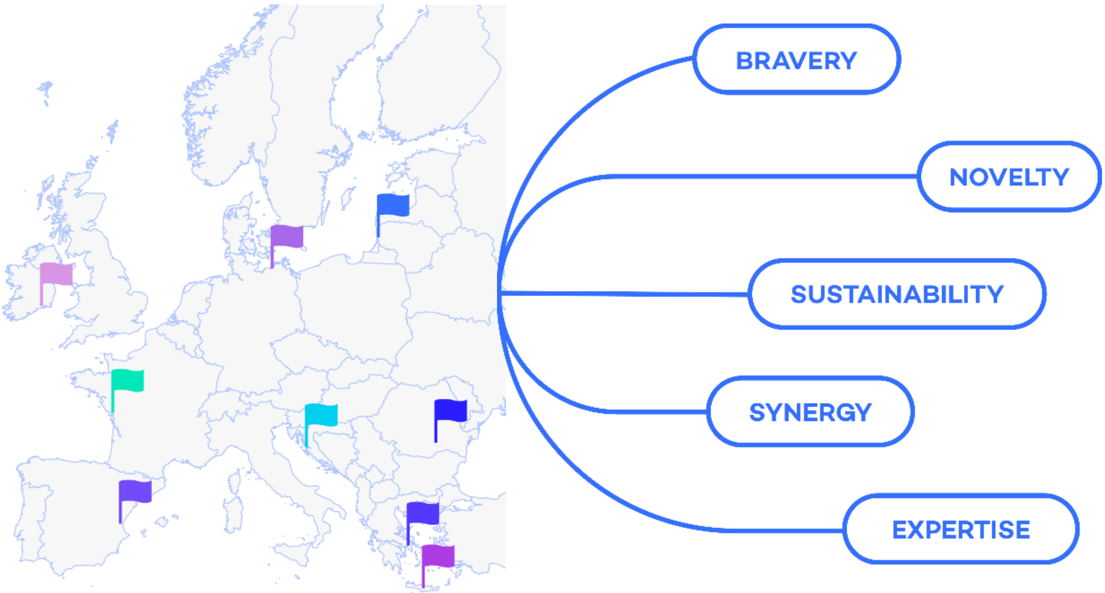
The students who choose the specialisation of **Blue Biomass** will focus on the production techniques of new sources of renewable of aquatic biomass. The students will be able to identify the industrial applications of the biomass of the marine organisms.

The students who choose the specialisation of **Marine Biorefinery** will focus on new approaches and developments for the use of marine biogenic feedstocks. The students will be able to maximise the usage of biomass for the manufacturing of new functional products from marine resources.

The students who choose the specialisation of **Aquaculture Biotechnology** will focus on the various uses of Biotechnology to the aquaculture sector. The students will be able to manage advanced breeding programmes, estimate significant diseases of aquatic organisms and assess the causes of the disease, modify the metabolism of molecules in living organisms and support modern research and analytical methods for practical aquaculture development and seafood processing.

The 'Academic Research Integration' course will be carried out parallel to the chosen track. The student will be able to work on proposed multidisciplinary research projects related to the chosen specialisation, designed by professors of different specialisations. This research-based course will give the opportunity to apply general academic, research and/or design skills in practice.

Courses description



Core courses

Genomics, Proteomics and Metabolomics for Marine Biodiversity Prospecting

Thematic area:	Language	Year	Semester	ECTS
Marine Omics	English	1	Autumn	6
Type:	Compulsory			
Cycle:	Second			
Synopsis:	The course will provide a theoretical and practical background on Genomics, Proteomics and Metabolomics techniques. In parallel, basic computer skills for large-scale data management will be provided. The main applications on these techniques on Marine Biodiversity Prospecting will be studied through case studies and expert seminars.			
Learning outcomes:	On successful completion of this course, students should be able to: • Efficiently combine a wide range of aspects and knowledge about genes, chromatin, chromosomes and (meta) genomes of marine (and freshwater) organisms. • Skilfully handle the main genome analysis tools • Accurately select the most relevant DNA sequencing techniques for marine bioprospecting • Interpret and justify fundamental concepts in Marine Genomics and Metagenomics • Design a highly detailed workflow for marine Proteomics analysis • Design a highly detailed workflow for marine Metabolomics analysis • Manage the capacity to characterise efficiently the marine genetic diversity.			
Mode:	face-to-face			
Content:	– Organisation and anatomy of genomes. – Alignment and comparison of genomes. – Basic bioinformatics tools and databases for genome analysis – Next-generation Sequencing Data Analysis Tools – Global vision of regulatory processes: specific metabolic routes and cross-talks. – Genome mining methods based on NGS: comparative genomics, phylogeny, resistance/target, regulators, cell culture and metagenomes. – Classical genome mining: search for enzymes and metabolic pathways involved in the biosynthesis of secondary metabolites. – Genomics applications to marine biotechnology. – Global analysis of the cellular transcriptome (qRT-PCR, microarrays, RNA-seq). – Applications of proteomics and metabolomics to marine biotechnology. – Workflow in Proteomics: sample preparation, parameters, tools, revelation and analysis of results. – Workflow in Metabolomics – Proteomics and Metabolomics Applications to marine biotechnology.			
Learning and teaching:	• Lectures: 28 h • Problem-based learning (PBL): 10 h • Computer sessions: 12 h • Seminars: 10 h			
Assessment:	• Single written exam: 40% • Report: 40% • Oral presentation: 20%			

Marine Microbiome and Metagenomics

Thematic area:	Language	Year	Semester	ECTS
Marine Omics	English	1	Autumn	6

Type:	Compulsory
Cycle:	Second
Synopsis:	Through a Research-Based Learning scheme, this course will provide hands-on training of the state-of-the-art microbiome and metagenomics techniques applied to the marine environment and biodiscovery. The students will have the opportunity to work on a complete workflow ranging from sample preparation to third generation sequencing and data analysis using advanced bioinformatic tools.
Learning outcomes:	On successful completion of this course, students should be able to: • Design a highly detailed workflow for marine metagenomics analysis • Accurately organise biological information in structured or unstructured databases • Aptly select the most appropriate tools for the analysis of patterns and traits in sequences and strings • Efficiently propose skills on 3-dimensional structural studies of macromolecules and small molecular weight compounds • Support in silico rational, structure-based, drug design and high throughput virtual screening of large chemical datasets • Choose meaningful genetic datasets from noisy databases • Conclusively argue on machine learning and deep learning pipelines in big genomic datasets • Interpret and judge patterns, trends, and correlations as well as to combine genomic data from large GWAS, exome or full genome sequencing.
Mode:	face-to-face
Content:	– Preparation of genomic libraries for high-throughput DNA sequencing – Next-generation sequencing of marine metagenomes – Next-generation sequence analysis: bioinformatic data formats, quality assessment and upstream data analysis – Genome assembly and annotation programs and workflows; basics of pangenomics. – Microbiome insight: metataxonomic analysis of marine samples for microbial population analyses – Metagenome assembly and annotation, taxonomic binning, gene quantification and metagenomes comparison – Introduction to functional metagenomics
Learning and teaching:	• Lectures: 5 h • Seminars: 4 h • Laboratory work: 15 h • Computer sessions: 35h
Assessment:	• Written exam: 40% • Report: 40% • Peer assessment: 10% • Oral presentation: 10%

Culture Collections and Biobanks

Thematic area:	Language	Year	Semester	ECTS
Marine Biodiversity Prospecting	English	1	Autumn	8
Type:	Compulsory			
Cycle:	Second			
Synopsis:	The most outstanding methodological approaches for conducting bioprospecting of cultivable aquatic organism will be provided. Essentially, the basis of collecting and preserving microorganism and microalgae collections will be covered, together with managing marine biobanks services.			
Learning outcomes:	On successful completion of this course, students should be able to: • Propose the most proper strategies for aquatic culturable microorganism bioprospecting • Assemble microorganism culture collections • Construct small scale biomass production units • Prepare DNA barcodes and create operational taxonomic units. • Revise traditional taxonomic identification vs omics tools. • Assess marine biobank roles and applications • Comprehensively interpret ethics, legacy, and risk management in biobanking.			
Mode:	face-to-face			
Content:	– Bioprospecting of aquatic culturable organism: bacteria, fungus, protists and microalgae; techniques for isolation, identification and purification. – Characterisation and proliferation techniques to obtain axenic clonal cultures from natural samples. – Microorganisms and microalgae culture collections establishment. – Cryopreservation methods for microorganisms and microalgae. – Small scale biomass production for R&D – DNA barcoding: generating clean DNA barcodes, tools to assign taxonomic names to DNA barcodes, and to cluster DNA barcodes into Operational Taxonomic Units. – Biobanking information technology. – Marine Biobanks: Marine Biological Resources for commercial R&D. – Marine Biobanks: Strain Deposit Services: Public or open deposit, restricted or private deposit and patent deposit.			
Learning and teaching:	• Lectures: 40 h • Seminars: 8 h • Computer sessions: 12 h • Laboratory work: 20 h			
Assessment:	• Single written exam: 40% • Practical exam: 20% • E-Portfolio: 20% • Report/project exam: 20%			

Blue Biotechnology Business & R&D Management (I)

Thematic area:	Language	Year	Semester	ECTS
Blue Biotechnology Business and R&D Management	English	1	Autumn	6
Type:	Compulsory			
Cycle:	Second			
Synopsis:	Students will reach an R&D strategic view rather than as a collection of development projects as a tool to translate innovation initiatives into a business plan generating innovative and entrepreneurial ideas in the blue biotechnological business. The transfer innovation to real market will be address using the Business Model canvas.			
Learning outcomes:	On successful completion of this course, students should be able to: • Interpret the dynamics of business and markets related to the biotechnology sector • Interpret insight into business opportunity development and the commercial realities faced by the industry through experiences shared by successful marine biotechnology entrepreneurs. • Discriminate among a wide range of internal organisational structures within the biotechnological sector to better meet the companies' internal needs while catering for varied economic sectors such as agri-food, pharmaceutical and aquaculture companies. • Appropriately propose and defend a business plan for a biotechnological development. • Estimate and evaluate business situations related to the management and organisation of biotechnology companies • Design the best course of action to implement an innovation plan that supplies greater strategic value to the organisation.			
Mode:	face-to-face			
Content:	– Business Strategy in the biotechnology company Internal and External analysis. Diagnosis, structure and implementation – The implementation of innovation: from the idea to the market introduction of new products and services – Developing a Business plan in Blue Biotechnology sector – Employability: entrepreneurship, intra-entrepreneurship, biotechnology consultancy. Exploitation of business and entrepreneurial opportunities – Developing an innovative and creative organisation – Employability workshops: creativity and innovation in R&D&I; leadership and teamwork; preparation for a job interview in Biotechnology – Innovation strategy and value creation for the companies in the biotechnology environment – The innovation process and biotechnological product development: from the idea to the market. – Business Model Canvas. Assessing business model design. Business Model Innovation. – Innovative thinking and creating value – Analysis of the biotechnological business environment: markets, products and networks – Strategic alliances as a tool for business growth in the Blue Biotechnology sector			

Learning and teaching:	• Lectures : 16h • Seminar: 4h • Business Project: 25h • Case of study: 10 • Simulation and Roleplay: 5h
Assessment:	• Oral Presentation: 30% • Project: 20% • Written report: 30% • Single written exam: 20%

Blue Biotechnology Business & R&D Management (II)

Thematic area:	Language	Year	Semester	ECTS
Blue Biotechnology Business & R&D Management	English	1	Spring	6
Type:	Compulsory			
Cycle:	Second			
Synopsis:	As a future manager involved in blue biotechnology innovation, students have to develop a crucial role to the blue sector organisation's competitive advantage, growth and profitability. A comprehensive exploration of the world of R&D&I and how it can drive competitive intelligence in technology transfer processes will be provided.			
Learning outcomes:	On successful completion of this course, students should be able to: • Interpret the dynamics of the biotechnological application to the transfer of R&D outcomes to companies and society • Prepare the basics of the application, planning, management of biotechnological R&D&I projects selecting the appropriate concepts and terms • Support the main steps for the development of goods and services in the field of Blue Biotechnology. • Select technological assets with a high probability of transfer for exploitation in the market. • Support the legal mechanisms to protect the outcomes of R&D&I through the most proper modalities of industrial and intellectual property.			
Mode:	face-to-face			
Content:	– Marine Biotechnology Pipeline. – Management of biotechnology R&D&I projects: drafting, planning, execution, and budget. – Introduction to technology transfer. – Industrial and Intellectual Property Rights. – Patents and Inventions – Complementary protection certificates. – Technology transfer models in Europe and the USA. – Management of R&D&I focused on technology transfer. – Agreements and contracts for the assignment or licensing of technology. – Technology transfer through the creation of companies and the formation of consortiums. – Relevance of technology watch and competitive intelligence in technology transfer processes. – R&D&I networks in Blue Biotechnology. – Understanding of the role of intellectual assets and property in innovation and business strategy – Concepts of IPR; Types of IP: patents; – Trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications; – IP as a factor in R&D and of relevance to blue biotechnology			
Learning and teaching:	• Lectures : 20h • Seminar: 8h • Discussions: 6h • Case of study: 20h • Problem base learning/ inquire base learning: 6h			
Assessment:	• Single written exam: 20% • Oral Presentation: 40% • Report: 40%			

Marine Biodiversity for Marine Natural Products

Thematic area:	Language	Year	Semester	ECTS
Marine Biodiversity Prospecting	English	1	Autumn	4
Type:	Compulsory			
Cycle:	Second			
Synopsis:	Diverse sampling and processing techniques of marine organisms in the water column and benthic environment will be used to identify the main groups of microorganisms, algae and invertebrates of interest in MNPs. International regulations and protocols on the use of marine genetic resources and biodiversity will be worked on.			
Learning outcomes:	On successful completion of this course, students should be able to: • Evaluate and measure marine biodiversity with a wide range of scales. • Formulate the factors which control patterns of marine biodiversity such as geological and evolutionary history. • Appraise and interpret the key conservation issues for marine biodiversity. • Efficiently arrange Bioprospecting and collection of marine samples campaigns. • Judge ethics and legality on access and utilisation of genetic resources.			
Mode:	face-to-face			
Content:	– The oceans as the last frontier of biodiversity: habitats to prospect new MNPs. – Main groups of organisms and microorganisms as a source of Natural Products: Bacteria (actinobacteria, cyanobacteria, proteobacteria, firmicutes), microalgae, macroalgae, invertebrates (poriferous, cnidarians, molluscs) and procordates (tunicates). Symbiotic microorganisms. – Microbiomes in aquatic and extreme environments. – Bioprospecting strategies and collection of marine samples: scuba-diving surveys, ROVs and submersibles, water column and sediment sampling. – International regulations on access and utilisation of marine genetic resources. – International treaty on marine biodiversity beyond national jurisdiction (BBNJ). – Nagoya protocol implementation and management			
Learning and teaching:	• Laboratory work: 10 h • Boat works: 5 h • Lectures: 15 h • Seminars: 5 h • Case studies 5 h			
Assessment:	• Single written exam: 40 % • Report/project: 60%			

Marine Natural Products (MNPs): Classes, Biological Activity and Biosynthesis

Thematic area:	Language	Year	Semester	ECTS
Biochemistry of Marine Natural Products	English	1	Spring	6
Type:	Compulsory			
Cycle:	Second			
Synopsis:	The immense biodiversity and chemodiversity of marine natural products will be presented, including ways of analysing their structure using spectral methods. The methods of bioprospecting and synthesis of these products will be discussed, including the search for biological activity in relation to their structure.			
Learning outcomes:	On successful completion of this course, students should be able to: • Interpret the major structural classes associated with key marine natural products (MNPs): lipids, peptides, sugars, terpenes, alkaloids, hybrids. • Convincingly argue on biodiversity and chemodiversity approaches, biogenetic source, and isolation source. • Conduct precursor directed biosynthesis and appraise total synthesis vs biomimetic synthesis and biosynthesis. • Assess biological activities and chemical structure of MNPs. • Design OSMAC (one strain many compounds) strategies to explore the Biochemical Diversity of Secondary Metabolites. • Evaluate the physiological and economic impacts of marine toxins. • Propose examples of marine emergent toxins.			
Mode:	face-to-face			
Content:	– Overview of the chemical richness of diverse marine living resources; Marine Natural Products: role in the discovery of leads for the development of drugs – Major structural classes associated with key marine natural products like peptides, sugars, terpenes, alkaloids, hybrids... – Differences between biogenetic source and isolation source. – Biodiversity and Chemodiversity – OSMAC (one strain many compounds) strategy: Exploring Biochemical Diversity of Secondary Metabolites. – Advantages and disadvantages of total synthesis vs biomimetic synthesis and biosynthesis – Relations between biological activities and chemical structure of MNPs (Structure-activity relationships (SARs)) – Marine toxins and their physiological and economic impacts			
Learning and teaching:	• Lectures: 40 h • Seminars: 5 h • Laboratory work: 15 h			
Assessment:	• Single written exam: 40% • Practical exam/Laboratory test: 20% • E-Portfolio: 20% • Oral presentation: 20%			

Chemical Libraries

Thematic area:	Language	Year	Semester	ECTS
Biochemistry of Marine Natural Products	English	1	Spring	6

Type:	Compulsory
Cycle:	Second
Synopsis:	Chemical libraries design and compounds database manage will be covered as tools for high-throughput screening and other processes for new added-value molecules development. The most outstanding chemoinformatics tools will be provide to research on Structure-Activity Relationships for better understanding of complex structures of chemical compounds.
Learning outcomes:	On successful completion of this course, students should be able to: • Construct substructure searches in large compound databases • Assess and interpret diversity and compound selection based on the needs of the given experiment • Select existing chemical libraries and propose compound & library design • Efficiently manage Chemoinformatics tools (Quantitative Structure-Activity Relationships (QSAR) • Choose biology oriented chemical synthesis or chemical synthesis (including divergent and diverted total syntheses), to produce bioactive natural product analogues and congeners • Revise existing strategies and compare late-stage modification strategies • Combine computational methodologies to explore marine natural products (MNPs) and support similarity searching and pharmacophore identification.
Mode:	face-to-face
Content:	– Introduction to in silico representation of chemical information – Overview of Rational Drug Design, Ligands and Targets – Quantitative structure-activity relationship (QSAR) (Hansch equation, Craig plot, Topliss scheme, Free Wilson approach). 3D QSAR approach (CoMFa). Use of chemoinformatics tools for QSAR rational approach – Definition of a chemical library – Presentation of existing chemical libraries – Molecular Drawing with ChemDraw and Interactive Visualisation (hands-on molecular drawing) – Data Mining in Chemical Databases – Design, Structured Query Language (SQL), Cloud Computing, Cambridge Structural Database – The Protein Data Bank (PDB) – Use of Ligand Explorer – Design SMILES -- Simplified Molecular Input Line Entry Specification – Molecular Modelling Tools – Force fields – Structural Homology Modelling Tools – Computer-Aided Drug Design Tools – Hands-on training on building a ligand from similar ligands – Hands-on training on building a ligand for a known macromolecular target – Hands-on training on performing Quantitative Structure-Activity Relationships (QSAR) with in silico tools
Learning and teaching:	• Lectures: 20 h • Computer sessions: 15 h • Project-based learning (PBL): 10 h • Laboratory work: 15 h
Assessment:	• Single written exam: 40% • Practical exam/Laboratory test: 20% • Report/project exam: 20% • Oral presentation: 20%

Screening of Bioactivity

Thematic area:	Language	Year	Semester	ECTS
Marine Biodiversity Prospecting	English	1	Spring	6
Type:	Compulsory			
Cycle:	Second			
Synopsis:	Prospection of bio-sourced ingredient with characterised mode of action is the first step to EU allegation obtention. This course gives an overview of the strategy to obtain added-value molecules with a particular bioactivity from marine biomass through sequential or integrated processes: sample preparation, extractive procedures, conversion processes, bioassays.			
Learning outcomes:	On successful completion of this course, students should be able to: • Propose sample preparation methods for complex matrices • Evaluate a wide range of extraction and separation techniques for marine feedstocks. • Formulate methodological approaches for conducting bioactivity assays • Judge the convenience of using animal models for bioactivity identification • Choose *in vitro* and *in vivo* bioassays for identification of bioactive fractions. • Organize screenings from *in vitro* to *in vivo* and choose adequate extraction method • Compare strategies using Structure-based (SB) and ligand-based (LB) chemoinformatics approaches			
Mode:	face-to-face			
Content:	– Sample preparation methods from complex matrices. – Methods of extraction of natural products: solvent extraction; solvent selection; solvent extraction techniques: maceration, percolation, reflux extraction. – Green extraction methods: supercritical fluid extraction (SFC), pressurized liquid extraction (PLE), ultrasound-assisted extraction (UAE) and microwave-assisted extraction (MAE). – Separation and quantification of natural products: thin-layer chromatography, high-performance liquid chromatography (HPLC/DAD, HPLC/FI), gas chromatography (GC / MS), supercritical fluid chromatography (SFC).Main extraction and purification techniques used in the context of biomass valorisation – Introduction to bioassay principles – Hit identification – Structure-based and ligand-based approaches – Bioassays targets and examples: ▪ molecules (genotoxicity, toxins, antioxidants, immunomodulation, enzyme involved assays), ▪ organelles (mitochondria membrane potential, membrane permeability) ▪ cells (viability, anticancer assays, cell migration, wound healing assays) ▪ tissues (hepatoxicity and hepatoprotective assays, permeability), – Animal models – Principles and equipment for high throughput assays			

	– Organ-on-chip approaches – Hands-on training on in vitro screening, obtaining, and analysing results – Isolation of bioactive fractions: Integration of separation process together with bioactivity monitoring for identification of active fractions in marine feedstocks
Learning and teaching:	• Lectures: 27 h • Seminars: 8 h • Laboratory work: 15 h • Case studies: 10 h
Assessment:	• Single written exam: 40% • Practical exam/Laboratory test: 20% • Report/project exam: 20% • Oral presentation: 20%

Tracks: Optional courses
Track 1. Innovative Bioproducts for Future

Biological profiling of Marine Natural Products

Track 1:	**Language**	**Year**	**Semester**	**ECTS**
Innovative Bioproducts for Future	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	The most outstanding methods (high-content-, high-throughput-, guided by in silico tools) for biological characterisation of active fractions from marine feedstocks will be provided. Procedures for prediction of bioactivities, functional properties and revealing of mechanisms of action in lead compounds will be covered.			
Learning outcomes:	On successful completion of this course, students should be able to: • Organise and perform a wide range of high-throughput and high content screenings. • Support in silico efforts to drug discovery. • Design methodological approaches for conducting bioactivity assays for biological profiling, including toxicity evaluation, pharmacology, and pharmacokinetic assays. • Estimate drug-likeness and predict adsorption, distribution, metabolism, excretion, and toxicity (ADMET) properties. • Conclude on bioactivities and reveal mechanisms of action.			
Mode:	On-line			
Content:	– Introduction to the process "from hit to lead". – Screening diversity (Iterative screening, smart, targeted screening, mixed-mode screenings (a combination of full screening and focused or speciality screening), high throughput screening (HTS), High-content screening) – Screening optimisation. Methods to increase the efficiency of screening (lead selection, promotion of interaction with therapeutic and chemical groups). – Screening guided by in silico tools (predictive tools for compounds and virtual screening, pathway analysis, and metabolic profiling) – Pathway approaches to understand the effect of a compound on an entire cell. – Biological characterisation of active fractions: specificity, selectivity, Absorption, Distribution, Metabolism, and Excretion (ADME), toxicity (hepatotoxicity, cardiotoxicity, neurotoxicity), – Prediction of bioactivities/functional properties – Mechanisms of action revealing			
Learning and teaching:	• Lectures: 20 h • Seminars: 10 h • Case studies: 10 h			
Assessment:	• Single written exam: 40% • E-Portfolio: 30% • Report/project exam: 30%			

Optimisation of Marine Natural Products

Track 1:	Language	Year	Semester	ECTS
Innovative Bioproducts for Future	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	After hit obtention, the step of their optimization is crucial. The most outstanding methods to increase the bioactivity of hits, through computer assisted design together with chemical or enzymatic modification will be covered to allow the production of new molecules with higher added value			
Learning outcomes:	On successful completion of this course, students should be able to: • Justify the steps going from target validation to commercial introduction of new marine therapeutic drugs • Evaluate and validate biomolecular structure and binding to small ligands through computer software tools and relevant databases • Estimate the strengths and limitations of various experimental and computational approaches for studying macromolecular structure and function • Design enzymatic or chemical processes for depolymerisation or functionalisation of biomolecules to obtain highly bioactive molecules • Evaluate the metabolism of new molecules in a living organism to ensure product safety.			
Mode:	On-line			
Content:	– Design processes for the discovery of new and more efficient leads – Repurpose known MNPs – Leads optimisation using Structure-based (SB) and ligand-based (LB) chemo-informatics approaches. – Targeting new metabolites based on genome analysis, – Performing similarity searching, and pharmacophore identification. – Improving pharmacokinetic (PK) parameters – Undertaking Molecular Dynamics and docking -binding cavity analysis approaches. – Identification and modification of the metabolism of molecules in living organisms – Post-market recommendations (purity, contaminants) – Chemical functionalisation: ▪ depolymerisation (by radical splitting, microwave heating, ultrasounds) ▪ addition of chemical groups (phosphate, sulphate etc.) – Biochemical functionalisation: ▪ enzymes use to depolymerize compounds ▪ enzymes use to add functional groups – Non-conventional enzymology (low water content, gas) – Enzymes in complex mixtures			
Learning and teaching:	• Lectures: 27 h • Seminars: 4 h • Computer sessions: 9h			
Assessment:	• Single written exam: 40% • E-Portfolio: 30% • Report/project exam: 30%			

Course: Marine Natural Products for Health and Wellness and Food

Track 1:	Language	Year	Semester	ECTS
Innovative Bioproducts for Future	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	Marine bioproducts can replace synthetic molecules with new biological activities. Health, disease and wellness targets definition as objectives to be achieved for new marine natural products will be provided. Mechanisms and procedures to demonstrate the relevant pharmacological and nutraceutical bioactivity of marine natural products in different manufacturing process stages in the way to the market will be highlighted.			
Learning outcomes:	On successful completion of this course, students should be able to: • Support the process to allow a compound into clinical development • Propose novel assays to identify/optimise new activities (biologically biotechnologically- and ecologically-relevant MNP bioactivities) • Interpret key terms, principles, and issues of pharmaceutical and biomaterials manufacturing, including physical processes, GMP related issues, pharmaceutical marketing, and clinical trials. • Estimate formulation requirements and determine proper manufacturing process stages to reach the market • Propose the use of macromolecules from Marine origin in food: lipids, carbohydrates, proteins, peptides			
Mode:	On-line			
Content:	– Health, disease and wellness definition – Methods to demonstrate pharmacologically-relevant MNP bioactivities like: antibacterial, antifungal, antimalarial, anti-inflammatory, anti-ageing (skin regeneration), anti-obesity, anticancer, pain relief, antibiofilm/fouling – Methods to propose novel assays to identify/optimize new biological activities ▪ MNPs for food ▪ Definition of food additives ▪ MNP (Marine Natural Products) to maintain or improve the safety of food ▪ MNP to maintain or improve the freshness, taste, texture, or appearance ▪ MNP for food processing ▪ Methods to demonstrate MNP functional properties			
Learning and teaching:	• Lectures: 30 h • Seminars: 10 h • Case studies: 10 h			
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40% • Oral presentation: 20%			

Advanced Characterisation Methods for Marine Natural Products Identification

Track 1:	Language	Year	Semester	ECTS
Innovative Bioproducts for Future	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	Since the advanced structural characterisation of a compound is an essential step in obtaining a health allegation, the most recent methods of structure elucidation will be presented, including their use in complex matrices.			
Learning outcomes:	On successful completion of this course, students should be able to: • Design a workflow with chromatographic methods for isolating new biochemical compounds from bioactive samples • Manage the chemical purification process of a newly isolated compound • Evaluate the chemical structure of high-added-value product from marine biomass • Propose molecular models and compare in-silico simulations • Revise validation and quality control of chemical analysis.			
Mode:	On-line			
Content:	– Isolation and Purification of secondary metabolites from bioactive samples. – Identification and analysis techniques: UV-vis spectroscopy, infrared spectroscopy (NIR), mass spectrometry (MS), nuclear magnetic resonance (NMR). – Dereplication techniques for searching novel natural products and metabolite identification. – X-ray crystallography technics. – Structural elucidation of Marine Natural Products. – High-resolution mass spectrometry and chromatography coupled systems (LC/MS) for identification of new metabolites in a complex matrix. – Nuclear magnetic resonance and chromatographic coupled systems for structural elucidation of complex matrix and biological processes – Method development, validation, and quality control of chemical analyses.			
Learning and teaching:	• Lectures: 20 h • Seminars: 10 h • Case studies: 10 h			
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40%			

Tracks: Optional courses

Track 2. Blue Biomass

Bioreactor Design and Management

Track 2:	**Language**	**Year**	**Semester**	**ECTS**
Blue Biomass	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	The most recent approaches to design and manage marine microorganisms and microalgae biomass production operations will be tackled. Hygienic practices, growth analysis and parameters monitoring of microorganisms and microalgae biomass and metabolites in different kinds of bioreactors will be covered.			
Learning outcomes:	On successful completion of this course, students should be able to: • Compare the features and performance of marine biomass production systems. • Estimate culture growth kinetics in marine biomass production systems • Design bioreactors and photobioreactors according to matter and energy balances • Measure culture parameters and interpret changes of biomass production by microorganisms • Propose hygienic practices in sampling design and harvesting procedures for microbial biomass production operations			
Mode:	On-line			
Content:	– Biomass production systems for marine microorganisms and microalgae: bioreactors, fermenters and photobioreactors. – Cell growth kinetics in different production systems. – Flow charts, matter, and energy balances for the quantitative design of bioreactors and photobioreactors. – Essential auxiliary systems for gas supply and removal and nutrient renewal, culture mixing, thermal and pH control. – Sampling and harvesting systems for biomass and metabolites. – Culture monitoring parameters and data collection – Hygiene procedures			
Learning and teaching:	• Lectures: 20 h • Seminars: 8 h • Problem-based learning (PBL): 12 h			
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40%			

Microorganism Biomass and Metabolite Production

Track 2:	Language	Year	Semester	ECTS
Blue Biomass	English	2	Autumn	4

Type:	Optional
Cycle:	Second
Synopsis:	The present-day knowledge to produce and manage heterotrophic marine microorganisms' biomass that contain different high value-added metabolites will be provided. Scaling processes for their industrial production will be addressed.
Learning outcomes:	On successful completion of this course, students should be able to: • Interpret ecological and metabolic biodiversity of marine heterotrophic microorganisms • Assess industrial applications of marine heterotrophic microorganism biomass and metabolite productions • Propose and justify strategies for marine heterotrophic microorganism biomass and metabolite productions • Design microorganism biomass and metabolite production systems • Manage microorganism biomass and metabolite production processes, including scale-up processes
Mode:	On-line
Content:	– Marine heterotrophic microorganisms' diversity in the context of biomass production – Industrial applications of marine heterotrophic microorganism biomass – Marine bacterial biomass production: Culture management and Harvesting methods – Marine protist biomass production: Culture management and Harvesting methods – Marine yeast/fungi biomass production: Culture management and Harvesting methods – Genetic and metabolic engineering of microorganisms for Production of Value-added Ingredients – Biosafety in heterotrophic microorganism's biomass production operations
Learning and teaching:	• Lectures: 20 h • Seminars: 8 h • Research based learning (RBL): 12 h
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40%

Microalgal Biotechnology

Track 2:	Language	Year	Semester	ECTS
Blue Biomass	English	2	Autumn	4

Type:	Optional
Cycle:	Second
Synopsis:	Production and Management of microalgae biomass, containing different high value-added metabolites, as well as the upstream processes for their industrial production will be further explored.
Learning outcomes:	On successful completion of this course, students should be able to: • Interpret the ecological and metabolic biodiversity of microalgae • Formulate industrial applications of microalgae • Choose between different trophic strategies for microalgal biomass production • Design microalgal biomass production systems • Manage scale-up processes and organize microalgal biomass production processes • Propose strategies to tailored microalgal biomass production
Mode:	On-line
Content:	– Microalgae: Biology and Taxonomy – Industrial Applications of Microalgae: Advances and Prospects – Phototrophic, mixotrophic and heterotrophic microalgal cultures. – Microalgal biomass culture systems: open ponds, photobioreactors and fermenters – Photobioreactors technologies. – Monitoring of Microalgal Processes and systems biology using -omic technologies – Modelling of Microalgae Culture Systems with Applications to Control and Optimisation – Strategies for the Production of Application-based custom Microalgae Biomass using Metabolic-Induction Strategies. – Genetic Engineering of Microalgae for Production of Value-added Ingredients – Biosafety in microalgal biomass production operations
Learning and teaching:	• Lectures: 20 h • Seminars: 8 h • Research based learning (RBL): 12 h
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40%

Seaweed Production

Track 2:	Language	Year	Semester	ECTS
Blue Biomass	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	The most important marine agronomy and seaweeds industrial applications will be addressed. Upstream processes for their sustainable production will be covered.			
Learning outcomes:	On successful completion of this course, students should be able to: • Interpret seaweeds diversity and estimate relevant biological features for marine agronomy • Select adequate industrial applications from various seaweeds resources. • Choose properly facility type for cultivation based on seaweed biological characteristics. • Assess ecological risks and environmental hazards of seaweeds aquaculture • Compare selective breeding technics of different seaweeds.			
Mode:	On-line			
Content:	– Seaweeds: Biology and Taxonomy – Industrial applications of seaweed biomass. – Sources of seaweeds: harvesting and aquaculture – Seaweed aquaculture: life cycle and production cycle. – Seaweed production facilities: hatchery and on-growth at sea – Seaweed production at Integrated multi-trophic Aquaculture (IMTA) – Ecological risks and environmental hazards – Selective breeding technology in seaweeds.			
Learning and teaching:	• Lectures: 20 h • Seminars: 8 h • Research based learning (RBL): 12 h			
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40			

Tracks: Optional courses
Track 3. Marine Biorefinery

Design of Biorefinery Processes

Track 3:	Language	Year	Semester	ECTS
Marine Biorefinery	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	The scale-up from research scale to industrial scale for marine biomass fractionation, purification and conversion to final products or energy will be covered. Innovative integrated processes will be presented.			
Learning outcomes:	On successful completion of this course, students should be able to: • Propose new ideas and approaches for the use of marine biogenic raw material, assessing risks and challenges • Setup new technologies in terms of added value throughout the whole value chain and propose strategies used to increase the yield of a particular target compound • Design downstream processes for marine biomass valorisation, including thermal, chemical, mechanical, and catalytic transformation • Design and implement the working principles of marine biomass fractionation and purification of a given chemical component from biological material • Propose methods to convert marine biomasses in energy			
Mode:	On-line			
Content:	– Overview of marine biorefinery success stories – Biomass standards for MNP production and downstream processes – Enzymatic or chemical biomasses pre-treatments – Reactor design – Research-scale extraction and fractionation methods (precipitation, solvent, filtration, centrifugation including novel separation technics (CO_2 ...) applied to Marine Natural Products recovery – Industrial-scale extraction and fractionation methods and constraints – Conversion processes including thermal, chemical, mechanical and catalytic transformation – Energy production from marine resources methanisation (Anaerobic digestion, various design of digesters)			
Learning and teaching:	• Lectures: 20 h • Seminars: 8 h • Problem-based learning (PBL): 12 h			
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40%			

Marine Biomass Functional Ingredients Extraction

Track 3:	Language	Year	Semester	ECTS
Marine Biorefinery	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	The current procedures for functional ingredients extraction from marine feedstocks will be provided. Applications for health, cosmetics, food and aquaculture of extracted functional ingredients will be underlined.			
Learning outcomes:	On successful completion of this course, students should be able to: • Compare and evaluate marine feedstocks as sources of functional ingredients • Combine fatty acids biorefinery processes • Design pigments and antioxidants extraction processes • Setup proteins, bioactive peptides, and amino acids recovery • Formulate polysaccharides extraction processes • Propose applications for health, cosmetics, food, and aquaculture of extracted functional ingredients			
Mode:	On-line			
Content:	– Diversity of feedstocks for functional ingredients supply – W-3 fatty acids extraction, refining and purification processes – Pigments and antioxidants extraction – Proteins, bioactive peptides and free amino acids extraction – Polysaccharides extraction – Fluorescence and other biotechnological substances (GFP, Taq polymerase etc.) – Food additives			
Learning and teaching:	• Lectures: 20 h • Seminars: 8 h • Research based learning (RBL): 12 h			
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40%			

Functionalisation of Marine-derived Biomaterials

Track 3:	Language	Year	Semester	ECTS
Marine Biorefinery	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	The most relevant methods and strategies for functionalization of marine-derived compounds will be provided. Design tools for scaffolds using marine-derived nanomaterials/nanocomposites will be covered. Biomedical applications for marine-derived biomaterials will be highlighted.			
Learning outcomes:	On successful completion of this course, students should be able to: • Formulate strategies for chemical, biochemical, and enzymatic functionalisation of marine-derived compounds. • Convincingly argue applications of several marine-based biomaterials. • Evaluate nanomaterials and nanocomposites for biomedical applications • Value marine-derived biomaterials for 3D bioprinting applications			
Mode:	On-line			
Content:	– Chemical functionalisation: depolymerisation (by radical splitting microwave heating, ultrasounds); addition of chemical groups (phosphate, sulphate etc.) – Biochemical functionalisation: enzymes use to depolymerise compounds; enzymes use to add functional groups – Non-conventional enzymology (low water content, gas) – Enzymes in complex mixtures – Enzymes immobilisation over marine-derived matrixes – Calcium phosphates marine-based biomaterials – Chitosan-based biocomposite scaffolds – Marine polysaccharides functionalisation for biomedical applications – Chitin nanomaterials and nanocomposites – Marine-derived biomaterials for 3D bioprinting applications			
Learning and teaching:	• Lectures: 20 h • Seminars: 8 h • Research based learning (RBL): 12 h			
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 30% • Oral presentation: 10%			

Marine Whole-cell Factories

Track 3:	Language	Year	Semester	ECTS
Marine Biorefinery	English	2	Autumn	4

Type:	Optional
Cycle:	Second
Synopsis:	Bioengineering approach to design biosynthetic manufacturing processes by using marine single cells as production facilities will be covered. Metabolic engineering tools for setting marine microorganisms as whole-cell factories will be provided.
Learning outcomes:	On successful completion of this course, students should be able to: • Evaluate the "One strain many compounds" strategy for setting a marine microorganism as cell factory. • Select candidates to cell factories using omics technics • Design biosynthetic manufacturing processes using metabolic engineering in marine microorganisms. • Propose genetic engineering to modify the metabolism of molecules in living organisms • Design cascade valorisation in whole-cell factories biorefining
Mode:	On-line
Content:	– Systems metabolic engineering – Algal cell factories applications – Fungi cell factories applications – Microbial cell factories applications – Cascaded valorisation in marine biorefining coupled to bioenergy production and fertilisers.
Learning and teaching:	• Lectures: 20 h • Seminars: 8 h • Research based learning (RBL): 12 h
Assessment:	• Single written exam: 40% • E-Portfolio: 20% • Report/project exam: 40%

Tracks: Optional courses
Track 4. Aquaculture Biotechnology

Aquaculture Systems and Seafood Processing

Track 4:	Language	Year	Semester	ECTS
Thematic area: Aquaculture Biotechnology	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	The latest advances in aquaculture technology and processing will be provided. Designing, constructing and maintain systems for farming aquatic organisms and their processing will be covered, in line with the food safety and environmental requirements.			
Learning outcomes:	On successful completion of this course, students should be able to: • Compare the outcome, the impact of different aquaculture systems and/or management tools and to evaluate the physiological and commercial characteristics of aquatic organisms with their potential for introduction in commercial production. • Choose production processes for certain types of products and evaluate the factors that affect the quality of fish products and select appropriate analytical methods to determine the quality and safety of raw materials and seafood products • Support modern research and analytical methods for collecting and interpreting data necessary for practical aquaculture biotechnology development and cultured seafood processing • Plan, arrange, conduct, and evaluate experiments on aquaculture in recirculating aquaculture systems under the rules of animal health and bioethics • Collect and study the newest academic literature and other information sources on different aquaculture types and technologies • Assess and to introduce research results to aquaculture practitioners, managers and seafood customers following standard trends accepted in aquaculture and blue-biotechnology business • Design the cultivation systems of aquatic organisms in line with safety and environmental requirements.			
Mode:	On-line			
Content:	– Definition, historical development, and importance of aquaculture worldwide. – Overview of the species and production systems. – Technology of marine and freshwater fish species production. – Biofilms in aquaculture. – Emerging species of fish in aquaculture. Crustacean and bivalve production. New species of crustaceans, bivalves, and other organisms in aquaculture. – Postmortal changes in fish fillets. – Methods and equipment for fish preservation using low temperature: low temperature by chilling using ice, seawater, ice slurry; super chilling and freezing using liquid refrigerant and cryogenic liquid; refrigerant equipment; the requirement of ice during chilling or freezing; – Methods and equipment for fish preservation using high temperature: dried in air, inert gas, salting, smoking, dehydration.			

	– Product stability and factors that affect it during storage. – Analysis of Indicators for biochemical, physical, and microbial degradation. – Risk Analysis Assessment and HACCP in processing and packaging. – Microbiological and sensory analyses as an indicator of fish and fish products quality. Novel processing and packaging technology. – Biotechnological improvements applicable to production systems. – Bioremediation applied to aquaculture production systems.
Learning and teaching:	• Lectures: 20 h • Seminars: 10 h • Problem-based learning (PBL): 10 h
Assessment:	• Single written exam: 40% • Oral exam: 40% • Report/project: 20%

Fish Nutrigenomics

Track 4:	Language	Year	Semester	ECTS
Aquaculture Biotechnology	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	The course will provide all the appropriate methodology to assess the nutritional needs of the aquatic organisms. Students will gain the ability to understand the impact of the genotype on the nutritional status, as well as gene regulation as a response to specific feed ingredients.			
Learning outcomes:	On successful completion of this course, students should be able to: • Assess the nutritional needs of cultured organisms and interpret the common principles of feeding processes. • Combine feeding process, effective feed conversion and assimilation. • Set up fishmeal and fish oil supplementation with the view to improve the Fish In Fish Out ratio. • Propose tools to analyse the impact of feeding and nutrition on gene regulation and proteome. • Plan feeding regimes taking account nutritional parameters on various developmental stages during production. • Estimate the impact of genotype on nutritional status and assess the genomic responses of reared organisms upon different diets.			
Mode:	On-line			
Content:	– Nutrients in aquaculture concerning dietary requirements of cultured organisms and presence in raw materials. – Feeding process, digestion, and assimilation of nutritive substances. – Principles of exchange of substances in cultured organisms. – Growth of cultured organisms and methods of estimation. – Feeding of warm and cold-water fish. Marine fish nutrition from larva to harvesting. – Feeding in aquaculture and environmental conditions. – Genotype and fish nutrition. – Feeding, feed supplementation and ingredient substitution on gene regulation and physiology. – The impact of nutrition on the transcriptome and proteome.			
Learning and teaching:	• Lectures: 20 h • Seminars: 10 h • Case studies: 10 h			
Assessment:	• Single written exam: 40% • Report/project: 40% • Oral presentation: 20%			

Health and Welfare in Aquaculture

Track 4:	Language	Year	Semester	ECTS
Aquaculture Biotechnology	English	2	Autumn	4

Type:	Optional
Cycle:	Second
Synopsis:	The advanced theoretical background related to animal health management and animal welfare in aquaculture will be provided. Essentially understanding the etiopathology, diagnosis, management, and treatment of the most important diseases, and importance of different tools and biosensors for health of farmed aquatic species will be covered.
Learning outcomes:	On successful completion of this course, students should be able to: • Estimate the most significant diseases of aquatic organisms, assess the causes of the disease, plan preventive measures, and predict possible ways of spreading and transmitting disease. • Argue the occurrence, transmission, and course of a disease. • Assess the hosts, the pathogens, and the environmental factors for disease outbreak. • Design tools and biosensors for control and prevention of contagious diseases. • Compose risk assessment plans and develop biosecurity measures. • Argue and determine the impact of husbandry practices on fish stress and welfare.
Mode:	On-line
Content:	– Definition of disease and development of the disease-related with host, causative agent, and environment. – Quantification of disease, determination of hosts, pathogens, and environmental factors. – Koch´s postulates, Evan's rules, and research variables. – The course of a disease. – Analysis of the occurrence and transmission of the disease. – Transmission of disease, risk assessment analysis for cultivated and wild populations. Defence of the organism and types of immunity. – Control and prevention of contagious diseases. – Risk analysis and the basics of biosecurity. – Disinfection and quarantine. – Methods of monitoring and sampling. Interaction between the cultivated and wild populations. – One Health approach. – Welfare aspects of cultured organisms. – Welfare indicators and the 3Rs concept. – Stress and welfare assessment. – Use of probiotics and nutraceuticals as a tool to improve health and well-being. – Biosensors for the detection of pathogens and biotoxins. – Preparation of vaccines (viruses, bacteria, parasites). – Detection of virulence and traceability of pathogenesis.
Learning and teaching:	• Lectures: 20 h • Problem-based learning (PBL): 10 • Seminars: 10 h
Assessment:	• Single written exam: 40% • Oral exam: 40% • Report/project: 20%

Advanced Breeding Programmes

Track 4:	Language	Year	Semester	ECTS
Aquaculture Biotechnology	English	2	Autumn	4
Type:	Optional			
Cycle:	Second			
Synopsis:	Define the factors that influence breeding objectives and consider the needs and priorities in aquaculture breeding programs. The students will be able to design breeding programs and monitor the outcomes, with special emphasis to the genomic toolkit that will facilitate the understanding of population structure and the enhancement of selective breeding efficiency.			
Learning outcomes:	On successful completion of this course, students should be able to: • Argue the environmental, nutritional, and endocrine control of reproduction, development, and growth. • Propose husbandry practices to increases production yield and quality characteristics of the aquaculture populations. • Design selection programs for production traits. • Set-up genetic and genomic tools for monitoring the performance of breeding programs. • Select gene manipulation techniques and applications in broodstock management.			
Mode:	On-line			
Content:	– Environmental, nutritional, and endocrine control of reproduction. – Principles of domestication and the application of genetic improvement in aquaculture. – The theoretical basis of genetic breeding and selection. – Breeding and selection strategies and how they are achieved by mating design. – Calculation of breeding values and the response of a population to selection. – Estimates of genotype and environmental fitness interactions. – Configuration and management of breeding stock. – Induction, control, and management of the reproductive cycle. – Techniques and applications of chromosomal manipulation. – Genetic markers and genetic mapping in aquaculture. – Quantitative Genetics, Quantitative Trait Loci, NGS-RAD and GWAS sequencing in aquaculture. – Genetic and genomic tools for broodstock management and improvement of aquaculture production. – The analysis of transcriptomic libraries applied to genetic improvement in aquaculture.			
Learning and teaching:	• Lectures: 20 h • Seminars: 10 h • Case studies: 10 h			
Assessment:	• Single written exam: 40% • Report/project: 40% • Oral presentation: 20%			

Research and practice-based learning courses

Internship

	Language	Year	Semester	ECTS
	English	1	Spring	6
Type:	Compulsory			
Cycle:	Second			
Synopsis:	The purpose of the internship is to provide students with an opportunity to apply their knowledge and skills autonomously and with responsibility in an industry setting. A wide range of organisations participate in the JMPMB: pharmaceutical, dermopharmacy, food and beverage, cosmetic and beauty and biotechnology companies and scientific institutions. The student will work under the supervision of an external supervisor (a company tutor in charge of the student's training). An internal supervisor (a university professor) will guide the student on how to organise the information on the tasks they carry out in the company, in order to draw up the Internship Report that will constitute their assessment evidence.			
Learning outcomes:	On successful completion of this course, students should be able to: • Collect and synthesise bibliographical information on a subject • Construct and organise proper experimentations and analyses of data • Assess and perform experiments • Argue and interpret results effectively • Communicate previously obtained results to the scientific audience • Formulate and justify alternative hypotheses • Value results towards a wide range of audience and using various supports			
Mode:	Face to face			
Content:	– Integration into a team dealing with a specific problem within the company or laboratory – Literature review on the topic – Choice, conception, and description of experiments to examine hypotheses – Conducting and analysis of experiments – Reporting of results – Discussion of results and proposal of new experiments for the assessment of alternative solutions – Communication inside a team and toward others trough written and oral presentations			
Learning and teaching:	• Supervision: 5 h • Project work: 145 h (individual work)			
Assessment:	• Report of the supervisor during the internship: 60% • Internship report: 40%			

Academic Research Integration (ARI)

	Language	Year	Semester	ECTS
	English	2	Autumn	14
Type:	Compulsory			
Cycle:	Second			
Synopsis:	R&D activities are very important issues in the current Marine Biotechnology status; R&D activities funding requires of participation of multidisciplinary teamwork from public research centres, universities and private companies; so, training professional skills related to scientific writing, project planning, management and presentation of research proposals to be developed in multidisciplinary teamwork is the aim of this Academic Research Integration (ARI) course. During the ARI the students from various partner universities and/or several specialisations will work together (in groups of 5-7) on a shared and transversal research project. The proposed multidisciplinary research projects, designed by professors of different specialisations, will give to the students the opportunity to apply general academic, research and/or design skills in practice. Each student will take part in this multidisciplinary project, carrying out the research activities related to his/her specialisation in one of the partner institutions. At the same time, the transversality will be encouraged through the collaboration between students from different specialisations and in different locations, adding up each student´s work and thus running a truly multidisciplinary joint research project. Every student will work closely with his/her Academic Supervisor, who will help him/her to meet the project´s milestones. All the members of the team will gain an interdisciplinary overview of the whole work because of their singular and collaborative work.			
Learning outcomes:	On successful completion of this course, students should be able to: • Assemble their academic knowledge and general academic skills and attitude to a multidisciplinary project dealing with a complex problem. • Plan the objectives and tasks of a project, in a consensual manner in a teamwork environment led by a mentor. • Design a project management plan, comply, and adjust it if circumstances make it necessary, in a teamwork environment led by a mentor. • Argue and defend their points of view and conclusions, professionally and academically correct within complex collaborative environments. • Comply effectively to the execution of a multidisciplinary project, performing the tasks committed according to their area of expertise, collecting, selecting, and interpreting information and managing it into the deliverables of the project. • Value the contribution of different perspectives in designing solutions for complex problems. • Evaluate aspects that are important for the successful execution of a project, such as project management, decision-making in a complex situation, team roles and team building.			
Mode:	Face to face			
Content:	Specific contents for specialization track in: 1. Innovative Bioproducts for Future: a. Hands-on training in high throughput screening (HTS) and High-content screening for lead biological profiling. b. Practice-oriented on functionalization and optimization of leads			

	c. Hands-on training on texture profile analyser uses for Marine Natural Products d. Practice-oriented on advanced analysis equipment for structural elucidation of marine natural products. 2. Blue Biomass: a. Hands-on training on managing bioreactors and photobioreactors b. Practice-oriented on culture management and harvesting methods of marine heterotrophic microorganisms c. Hands-on training on culture management and harvesting methods of microalgae d. Practice-oriented on culture management of seaweeds 3. Marine Biorefinery: a. Hands-on training on research-scale conversion methods applied to integrated MNPs recovery b. Practice-oriented on extraction and preservation procedures of functional ingredients from marine biomass c. Hands-on training on construction of 3D bioprinted scaffolds using marine-derived biomaterials. d. Practice-oriented on setting laboratory biosynthetic manufacturing process by using marine whole-cell factory candidates. 4. Aquaculture Biotechnology a. Hands-on training on biotechnological aquaculture facilities evaluation. b. Practice-oriented on biotechnological tools for aquaculture nutrition research c. Hands-on training on biotechnological tools for aquaculture diseases research d. Practice-oriented on aquaculture breeding programs.
Learning and teaching:	• Laboratory works: 20 h • Workshops: 30 h • Field work: 10 h • Research-based Learning: 80 h
Assessment:	• Practical exam/Laboratory test: 20% • Report/project exam: 20% • Peer assessment: 20% • Oral presentation: 20% • Poster presentation: 20%

Master thesis

	Language	Year	Semester	ECTS
	English	2	Spring	30
Type:	Compulsory			
Cycle:	Second			
Synopsis:	Master thesis will be carried out by the student in one of Partners', Associated Partner universities or other higher education and/or research institution according to the chosen Master thesis topic. Before starting the Master thesis work, the student must have completed all previous courses and gained at least 90 ECTS. During the thesis work, students will focus on a specific subject for a certain amount of time. The students will work under the supervision of a thesis supervisor and, if relevant, a co-supervisor. During thesis work, students will able to apply the techniques and knowledge they gained during the courses in the three previous semesters.			
Learning outcomes:	On successful completion of this course, students should be able to: • Assess the state of art and trends that allow going from idea to bioproduct and bio services • Formulate hypothesis, design, and reorganise experiments/research skill scientifically to solve and evaluate observed phenomena in a creative way • Design bioprocesses using advanced and innovative scientific and critical thinking approaches and formulate alternative solutions • Set up lifelong learning skills by conducting independent work with minimum supervision. • Construct professional ethics in research and explain ethics related to biotechnology from spiritual and material aspects • Argue, interpret and report results effectively with a range of audiences in national and international contexts			
Mode:	Face to face			
Content:	– The final product of Master thesis is a written document ('Master thesis', 'thesis') stating the main scientific results. The Master thesis results are presented and defended publicly ('Master thesis defence'). – Master thesis projects can be academic in nature or developed within the industry. It includes the following tasks: – Integration into a team dealing with a specific problem within the institution – Literature review on the topic – Integration of knowledge and skills acquired in the programme with practice (research and other), in realistic work situations – Acquisition of further relevant knowledge, skills, and understanding in practical situations within the work environment – Choice, conception, and description of experiments to examine hypotheses related to the problem to be solved – Conducting and analysis of experiments or modelling – Reporting of results – Discussion of results and proposal of new experiments for the assessment of alternative solutions – Communication inside a team and toward others through written and oral presentations			

	– Learning to function independently and responsibly within an organisation
Learning and teaching:	The Master thesis is an individual work of the student under the supervision of the professor ('supervisor').
Assessment:	• Assessment of the Master thesis manuscript: 70 % (20% supervisor, 50% Jury) • Public defence (oral presentation): 30%.

Learning outcomes matrix

Intended Learning Outcomes/ Courses		MARINE OMICS		MARINE BIODIVERSITY PROSPECTING		BIOCHEMISTRY OF MARINE NATURAL PRODUCTS			BLUE BIOTECHNOLOGY BUSINESS AND R&D MANAGEMENT	
		Genomics, Proteomics and Metabolomics for Marine Biodiversity Prospecting	Marine Microbiome and Metagenomics	Culture Collections and Biobanks	Marine Biodiversity for Marine Natural Products	Marine Natural Products: Classes, Biological Activity and Biosynthesis	Chemical Libraries	Screening of Bioactivity	Blue Biotechnology Business and R&D Management (I)	Blue Biotechnology Business and R&D Management (II)
Knowledge: Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research Critical awareness of knowledge issues in a field and at the interface between different fields	**On successful completion of this programme, students should be able to demonstrate comprehensive and specialised knowledge and understanding of:**									
	K1 - The wide biodiversity of marine genetic resources as a starting point to search for new bioactive compounds.	X	X	X	X	X	x	X	X	X
	K2 - State-of-the-art techniques for extraction, identification and functionalization of new molecules associated with bioactivities from marine origin feedstocks.					X	X	X		
	K3 - Validation processes of brand-new marine bioproducts for their application to biomedicine, cosmetics and agri-food sectors.		X						X	X
	K4 - Innovative procedures for the optimization and improvement of functional compounds biosynthesis derived from marine organism cultures.					X	X	X		
	K5 - Environmental marine microbiome as a biotechnology approach to ecosystem management.	X	X	X	X	X		X		
	K6 - Advanced culturing techniques for a wide range of aquatic organisms suitable for biomass production.			X	X	X				
	K7 - Current strategies for funding, protection, transfer and commercialization of R&D results in the biotechnological business environment.	X		X			X	X	X	X
Skills: Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields	**On successful completion of this programme, students should be able to:**									
	S1 - Develop a workflow with highly specialized analytic equipment to discover new molecules with specific bioactivity	X	X			X	X	X		
	S2 - Prepare in-vitro and in-vivo assays for validation of new bioproducts.	X				X	X	X		
	S3 - Propose cutting-edge biotechnological processes for biomass production from marine organisms.			X						
	S4 - Comprehensively assess patterns, trends and correlations from genomic data analysis for environmental applications.	X	X	X	X					
	S5 - Integrate avant-garde selective breeding programmes as a tool for a sustainable aquaculture.									
	S6 - Evaluate the relevance of laboratory results in order to choose next steps in bioproduct discovery roadmaps.	X	X			X	X	X	X	X
	S7 - Extensively interpret entrepreneurial opportunities within biotechnology research to successfully launch new products and services in an emerging market.	X			X	X		X	X	X
	S8 - Formulate ground-breaking proposals to make the emerging sector of Blue-biotech more visible and attractive for stakeholders to consider as a viable investment venue to further develop research focused on an industrial application.	X	X		X	X		X	X	X
	S9 - Efficiently integrate problem-solving skills and specialised knowledge and understanding from Blue-biotech for innovative solutions to current challenges concerning marine organisms.		X	X		X	X	X	X	X
	S10 - Set up an efficient biotechonological pipeline to develop innovative marine natural products.	X	X	X	X	X	X	X	X	X
Responsibility and autonomy: Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams	**On successful completion of this programme, students should be able to:**									
	R1 - Collaborate, manage, and lead multidisciplinary working groups to facilitate transnational and cross-border development of innovation and research projects to provide a coherent all-inclusive framework for the emerging sector of blue biotechnology.	X	X	X		X		X	X	X
	R2 - Efficiently and skilfully manage a wide range of sophisticated laboratory equipment to carry out assigned tasks individually or in a collaborative working environment.		X	X			X	X		
	R3 - Create and manage entrepreneurial and innovative approaches to Blue-biotech to maximize its transformative impact on biomedicine, cosmetics and agri-food sectors.								X	X
	R4 - Comply with the standards set by social responsibility and civic awareness to establish pioneering business models for a sustainable biotech industry.	X		X	X			X	X	X
	R5 - Convincingly communicate scientific results in the emerging field of Blue-biotechnology to an audience of peers and non-peers by means of highly organized, coherent, and cohesive both written and oral discourses to contribute to the betterment of the field.	X	X			X	X	X	X	X

Intended Learning Outcomes/ Courses		TRACK 1 - INNOVATIVE BIOPRODUCTS FOR FUTURE				TRACK 2 - BLUE BIOMASS				TRACK 3 - MARINE BIOREFINERY				TRACK 4 - AQUACULTURE BIOTECHNOLOGY				RESEARCH AND PRACTICE - BASE LEARNING		
		Biological Profiling of Marine Natural Products	Optimisation of Marine Natural Products	Marine Natural Products for Health and Wellness and Food	Advanced Characterisation Methods for Marine Natural Products	Bioreactor Design and Management	Microorganism Biomass and Metabolite Production	Microalgal Biotechnology	Seaweed Production	Design of Biorefinery Processes	Marine Biomass Functional Ingredients Extraction	Functionalisation of Marine-Derived Biomaterials	Marine Whole-Cell Factories	Aquaculture Systems and Seafood Processing	Fish Nutrigenomics	Health and Welfare in Aquaculture	Advanced Breeding Programmes	Internship	Academic Research Integration	Master Thesis
Knowledge: Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research Critical awareness of knowledge issues in a field and at the interface between different fields	**On successful completion of this programme, students should be able to demonstrate comprehensive and specialised knowledge and understanding of:**																			
	K1 - The wide biodiversity of marine genetic resources as a starting point to search for new bioactive compounds.	X			X		X	X	X	X			X	X				X	X	X
	K2 - State-of-the-art techniques for extraction, identification and functionalization of new molecules associated with bioactivities from marine origin feedstocks.		X		X					X	X	X	X	X	X	X		X	X	X
	K3 - Validation processes of brand-new marine bioproducts for their application to biomedicine, cosmetics and agri-food sectors.	X	X	X	X						X	X	X	X	X	X		X	X	X
	K4 - Innovative procedures for the optimization and improvement of functional compounds biosynthesis derived from marine organism cultures.	X	X	X	X		X	X	X	X	X	X	X		X	X		X	X	X
	K5 - Environmental marine microbiome as a biotechnology approach to ecosystem management.	X	X		X		X	X			X		X	X	X	X		X	X	X
	K6 - Advanced culturing techniques for a wide range of aquatic organisms suitable for biomass production.					X	X	X	X				X	X	X	X	X	X	X	X
	K7 - Current strategies for funding, protection, transfer and commercialization of R&D results in the biotechnological business environment.		X	X			X	X	X		X	X	X		X	X	X	X		X
Skills: Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields	**On successful completion of this programme, students should be able to:**																			
	S1 - Develop a workflow with highly specialized analytic equipment to discover new molecules with specific bioactivity.	X	X	X	X					X	X	X	X		X	X				X
	S2 - Prepare in-vitro and in-vivo assays for validation of new bioproducts.	X	X	X	X						X	X	X		X	X				X
	S3 - Propose cutting-edge biotechnological processes for biomass production from marine organisms.		X			X	X	X	X				X	X	X	X	X			X
	S4 - Comprehensively assess patterns, trends and correlations from genomic data analysis for environmental applications.						X	X	X					X	X	X	X			X
	S5 - Integrate avant-garde selective breeding programmes as a tool for a sustainable aquaculture.						X	X	X					X	X	X	X		X	X
	S6 - Evaluate the relevance of laboratory results in order to choose next steps in bioproduct discovery roadmaps.	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X
	S7 - Extensively interpret entrepreneurial opportunities within biotechnology research to successfully launch new products and services in an emerging market.		X	X			X	X	X		X	X	X	X	X	X	X	X	X	X
	S8 - Formulate ground-breaking proposals to make the emerging sector of Blue-biotech more visible and attractive for stakeholders to consider as a viable investment venue to further develop research focused on an industrial application.	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X
	S9 - Efficiently integrate problem-solving skills and specialised knowledge and understanding from Blue-biotech for innovative solutions to current challenges concerning marine organisms.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	S10 - Set up an efficient biotechonological pipeline to develop innovative marine natural products.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Responsibility and autonomy: Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams	**On successful completion of this programme, students should be able to:**																			
	R1 - Collaborate, manage, and lead multidisciplinary working groups to facilitate transnational and cross-border development of innovation and research projects to provide a coherent all-inclusive framework for the emerging sector of blue biotechnology.													X		X		X	X	X
	R2 - Efficiently and skilfully manage a wide range of sophisticated laboratory equipment to carry out assigned tasks individually or in a collaborative working environment.																	X	X	X
	R3 - Create and manage entrepreneurial and innovative approaches to Blue-biotech to maximize its transformative impact on biomedicine, cosmetics and agri-food sectors.																		X	X
	R4 - Comply with the standards set by social responsibility and civic awareness to establish pioneering business models for a sustainable biotech industry.	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X
	R5 - Convincingly communicate scientific results in the emerging field of Blue-biotechnology to an audience of peers and non-peers by means of highly organized, coherent, and cohesive both written and oral discourses to contribute to the betterment of the field.			X								X				X	X		X	X