



Learning from the planned learning outcomes and curriculum of Educational programs aimed at Bioeconomy study

Antonio Marzocchella

Department of Chemical, Materials and Industrial Production Engineering

Università degli Studi di Napoli Federico II

May 19, 2022

antonio.marzocchella@unina.it

UNIVERSITY OF NAPLES FEDERICO II



federico II

Frederick II Hohenstaufen King of Sicily and Holy Roman Emperor established the University of Naples as the Studium with an Imperial Charter, on June 5th, 1224.



Aicine Alago Alago

School of Agriculture and Veterinary Medicine President: Prof. Giuseppe Cringoli

> School of Polytechnic and Basic Sciences *President: Prof. Gioconda Moscariello*

> > School of Human and Social Science President: Prof. Aurelio Cernigliaro

> > > School of Medicine President: Prof. Maria Triassi



UNIVERSITY OF NAPLES FEDERICO II

School of Agriculture and Veterinary Medicine

School of Polytechnic and Basic Sciences

School of Human and Social Science

School of Medicine

Department of Agriculture http://agraria.dip.unina.it/

Department of Architecture www.diarc.unina.it

Department of Advanced Biomedical Sciences http://scienzebiomedicheavanzate.dip.unina.it/ Department of Biology http://biologia.dip.unina.it/

Department of Civil, Building and Environmental Engineering http://dicea.dip.unina.it/

Department of Chemical, Materials and Industrial Production Engineering www.dicmapi.unina.it

Department of Chemical Sciences http://scienzechimiche.dip.unina.it/

Department of Clinical Medicine and Surgery http://dmcc.dip.unina.it/

Department of Earth, Environment and Resources Sciences www.distar.unina.it

20 Pepartments

Department of Economics, Management and Institutions http://economia_management_istituzioni.dip.unina.it/

Department of Economics and Statistics

Department of Electrical and Information Technology Engineering www.dieti.unina.it

Department of Humanities http://studiumanistici.dip.unina.it/

Department of Industrial Engineering www.dii.unina.it

Department of Law www.giurisprudenza.unina.it

Department of Mathematics and Application www.dma.unina.it

Department of Molecular Medicine and Medical Biotechnologies http://dmmbm.dip.unina.it/ Department of Neuroscience, Reproductive Sciences and Dentistry http://neuroscienze.dip.unina.it/

Department of Pharmacy *http://farmacia.dip.unina.it/*

Department of Physics *www.fisica.unina.it*

Department of Public Health http://sanitapubblica.dip.unina.it/

Department of Political Sciences http://scienzepolitiche.dip.unina.it/

Department of Social Sciences www.scienzesociali.unina.it

Department of Structures for Engineering and Architecture www.dist.unina.it

Department of Translational Medicine www.medicinatraslazionale.unina.it

Department of Veterinary Medicine and Animal Production www.mvpa.unina.it



The School Polytechnic Basic Sciences

College of Architecture

College of Engineering

College of Basic Sciences

EDUCATION AND TRAINING

Education and training are crucial for the future of bioeconomy

The transition to a more '**green**' and environmentally sustainable economy requires **education and training systems** to support the overall process.

The role of vocational education in enabling the transition as part of the European Green Deal, the United Nations' Sustainable Development Goals (SDGs) and country targets of net-zero carbon emissions. 15 APR 2021



A set of the Educational programs offered @ UNINA

- The MSc in Molecular and Industrial Biotechnology
- The MSc in Chemical Engineering
- The MSc in Industrial Chemistry for Circular and Bio Economy
- The Minor Green Technology
- The Master BioCirce



LM - "Biotecnologie Molecolari e Industriali" <u>Classe LM-8</u>



MSc - "Molecular and Industrial Biotechnology" Master group LM-8

www.biotecnologieindustriali.unina.it/it/

www.biotecnologieindustriali.unina.it/en/



Biotecnologie Industriali Federico II

BiotecnologieindustrialiFII

Green and White Biotechnology MSc courses in Italy



Industrial Biotechnology







The strength of the MSc in Molecular and Industrial Biotechnology

- The potential of biotechnological products (e.g. antioxidants, pigments, antimicrobial, ...) to be safely used in a wide spectrum of applications, from the daily life (e.g. cosmetics, detergents, ...) to the technological devices (e.g. biosensors, cutlery,).
- Progressive (and expected massive) affirmation of experts in the exploitation of renewable resources for the production of "consumables" (energy carriers, plastics, lubricants, pigments, nutraceuticals, etc.) via biotechnological processes.
- Companies, enterprises, and R&D centers ASK for industrial biotechnologists characterized by knowledge in specific skills.
- Training must take into account pure biological-genetic aspects, biochemical aspects, methodologies for industrial development, and economic perspective that takes into account the balance between environmental and entrepreneurial benefits.

The structure of the MSc in Molecular and Industrial Biotechnology

A common path (4 exams – 30 ECTS) – Italian language

Two curricula (6 exams - 57 ECTS)

Curriculum: Biotechnology productions – ProBio – Italian language

 Focused on molecular and industrial aspects of biotechnology to educate students to a general integrated approach to consolidated and emerging technologies.



Curriculum: Biotechnology for Renewable Resources – BiRRe – English language

 Focused on molecular and industrial issues of biotechnology to prepare students to the construction of new products and services based on the exploitation of renewable resources.



MSc "Molcular and Industrial Biotechnology" Curriculum: Biotechnology for Renewable Resources

(English language: 57 ECTS)

Course	Module (if present)	ECTS					
Year I – I semester							
Industrial microbiology and fermentation chemistry (IT)		6					
Microalgal exploitation	Genetic en	6					
Industrial Biotechnologies And Environment Protection	Indur Jo P Jgies	6					
(IT)	E Iety Biotechnologies	6					
Year I – II OV 12							
Transport Phenomena for Biotechnological Applicati	N' S'	9					
20	based bioplastics	6					
Biopolymers and Bioplastics	Accharide- and protein- based	6					
Biorefinery processes		6					
- I semester							
Hygiene Background for Biotechr		6					
	Bioreactors	6					
Design of conversion procee	Process simulation	6					
Biosensors and Biochin		6					
Environmental econ		6					
Year II – II semester							
Free selection p		12					
Practical training		18					
Final project and exa		3					

(IT) – course language: Italian

MSc Chemical Engineering

Three curricula: Process Engineering – Italian language Product Engineering – English language Sustainable Engineering - English language

MSc Chemical Engineering

Curriculum Sustainable Engineering





MSc - "Industrial Chemistry for Circular and Bio Economy" <u>Master group LM-8</u>









The MSc Course at a glance

The degree course is offered jointly by the **University of Naples Federico II** and the **Politecnico di Torino**.

The course is in **English** and in mixed form (10-25% MOOC, 5-20% Distance Learning Courses).

The contact with the two territories, mediated by the joint University-Industry training actions (**Challange** and **Degree Thesis**), will allow the birth of new integrated and circular production paths. The idea of the new joint degree course was born from the previous relationships between research groups of UNINA and POLITO who noted how their complementary skills could be put into a system for the creation of a training offer that would meet the new needs that have emerged in the industrial world.

The synergy of **UNINA** and **POLITO** is also consolidated by the different economicindustrial context that will allow a transfer of skills and knowledge between the two territories.

The course has a strong **international vocation** with the two locations can be a pole of attraction for both students from northern Europe and the Mediterranean area.

WEBSITE: http://www.scienzechimiche.unina.it/iccbe



Enrolment procedure

Enrolment is limited to a maximum of **30 participants**.

Certified English language proficiency at the **B2 level** is required.

Admission is also permitted if at least 1 of the following curricular requirements is met:

- Requirement 1: Candidates who have graduated in Italy, class L-27 Chemical Sciences and Technologies.
- ✓ Requirement 2: Candidates with an Italian degree in classes L-2 Biotechnology or L13- Biological Sciences, but who have acquired the following CFU:
 - 8 CFU in the subject areas: MAT/01 to 09
 - 6 CFU in the subject areas: FIS/01 to 08
 - 15 CFU in the subject areas: CHIM/01 to 07
 - 15 CFU in the subject areas: AGR/16, BIO/10, BIO/11, CHIM/11, ING-IND/25, ING-IND 27.
- Requirement 3: candidates with a foreign university degree with a curriculum corresponding, in terms of content, to requirements 1 or 2 indicated above.



The study programme – YEAR I

		YEAR I - SEMESTER I			
Possible tudents with		Circular Platforms for energy and materials Recovery	10 (5+5)		
different cultural		Industrial Chemistry 8			
Dackgrounds two alignment paths are provided to ensure the achievement of the specific objectives of the training path. Chemis semest	YEAR I	Polymers: production, recycle and characterization			
		Green Unit Operations 9			
		Industrial Biotechnology 7			
	(8 exams)	Additional language skills (Italian) or further knowledge of computer science	3		
	stry ster sem	Bio nester			
YEAR I - SEMESTER I		Bioinorganic Chemistry and Industrial			
Complements of Physical and Analytical Chemistry 11 (6+5)		Enzymology	(0+5)		
Complements of Physical and Analytical Chemistry		Complements of Microbiology and			
Complements of Inorganic and Organic Chemistry	10 (5+5)	Biotechnology			



The study programme – YEAP



Minor in Green Technologies

Minor - educational structure that may be

- an extension of the MSc (+ 10 ECTS)
- post MSc (30 ECTS)
- Issued by an Open Badge

Transition Engineering program @ UNINA Two minors:

- Green Technologies
- Smart Infrastructure

Why a Minor in Green Technologies?

The sustainable development goals pose multidimensional problems that integrate technological, environmental, economic and social dimensions.

Engineers can make important contributions to the identification of 'sustainable' processes, products and services, provided they take in due account the complex multidimensional character of the problems.



Why a Minor in Green Technologies?

The deployment of advanced technological solutions to support the **circular economy** requires the control of material transformations and energy conversions, the prevention of pollutant emissions, and the optimisation of production and consumption cycles.

Processes and products must be examined from a Life Cycle Thinking perspective using the tools of Industrial Ecology.



The cultural profile of the *Green Technology Developer*

The Green Technology Developer is a professional

with specialized skills in the development and deployment of solutions (multidisciplinary approach)

➤ aimed at

 sustainable transformation of matter, production of goods and delivery of services,

 \checkmark the production, use and storage of energy,

- ✓ the efficient use of resources,
- ✓ the implementation of circular economy,

✓ the preservation of biodiversity,

✓ the prevention of pollution.

Educational activities

Dedicated educational activities

Green and regenerative chemistry; Control, monitoring, prevention and treatment of waste and pollutant emissions; Sustainable production, storage and distribution of energy; Design and reconversion of goods production and service delivery systems with a view to sustainability: bio-economy, circular economy, industrial symbiosis; Framing of material and energy transformation processes in the principles of industrial ecology.

Further abilities and interdisciplinary skills

Digital tools to support the greening of processes and products; Fundamentals of legal/regulatory, economic and managerial culture related to energy, environment, sustainability.

MSc students that may apply for the Green Technology Minor

- Chemical Engineering (LM-22)
- Electrical Engineering (LM-28)
- Mechanical Engineering for Energy and Environment (LM-33)
- Environmental Engineering (LM-35)
- Materials Engineering (LM-53)

Teaching module		Credits	
Energetica		9	Edu
Tecnologie avanzate per l'energi	a	9	
Modellazione avanzata di sistem termodinamici	ni	9	
Sistemi di propulsione per l'autotraz	zione	9	
Sperimentazione e impatto ambien delle macchine	tale	9	
Smart and Electric Mobility		9	
Smart Energy Water		9	12
Smart, Resilient and Sustainable (City	9	201 51
Energia dai Rifiuti ed Economia Circ	olare	9	OWNER
Idraulica per l'efficienza dei sistemi		R	c Dur the
Materiali e tecnologie per il fotovol	ŀ	STAC	R by reen
Ingegneria dei materiali nanofasic' l'energetica e la sensoris t '	<	(IRS)e	Jitio Engineering
			nical technologies for ergy transition
	.1	ar bioecor t	nomy for the ecologi ransition
		Sustain	able materials

Educational activities



6



When Academy and Industries meet together for growing of Bioeconomy

European competence framework for a new generation of European citizens









Italian Recovery and Resilience Plan

MISSION 4. EDUCATION AND RESEARCH

M4, C1 - ENHANCEMENT OF THE OFFER OF EDUCATION SERVICES: FROM KINDERGARTENS TO UNIVERSITIES

Human capital infrastructures: first point, the contamination of knowledge

Contamination of knowledge is fundamental, and it is especially true in the <u>training courses</u> of the new generations. A diversification of addresses and individual subjects is necessary, because each individual is different and may have different needs. That is, the student can shape his own education following his character and his abilities.





Education and training

Education, training, and communication are crucial for the future of bioeconomy

A strong interconnection among education providers, producers, workers, citizens, researchers and innovators should be supported and facilitated

Duty of Academia is training new professional profiles with technical and economic expertise (re-design of biotechnological processes, preservation and use of renewable natural resources, zero waste solutions) which will be **able to work within the bio-based goods and services industry**





Bioeconomy in the Circular Economy - BIOCIRCE

The first European Master in Bioeconomy in the Circular Economy

Biocirce is an interdisciplinary II Level Master jointly offered by 4 Universities: **University of Milano-Bicocca University of Napoli Federico II University of Bologna University of Torino**













The University of Milano-Bicocca





UNIMIB is considered one of the leading Universities in Europe in the field of **Industrial Biotechnology** research and has clearly identified **Synthetic Biotechnology**, **Metabolic Engineering, System Biology** and the economics of sustainability and the circular economy as key areas for future research. Since its birth (**10 June 1998**) Bioeconomy and Sustainability are among the main policy strategies for education.





The University of Napoli Federico II

The oldest state university of the western **word** (generalis lictera issued by Frederick II Hohenstaufen, King of Sicily and Head of the Roman Empire, June 5th 1224.), provides specific courses (Bachelor, Master and PhD) to train new professionals profiles to work within the bio-based goods and services industry. Together with the **Politecnico of Torino**, UNINA founded a MSc in Industrial Chemistry for Circular and Bio Economy, to train professionals with transversal Industrial skills in Chemistry, Biotechnology and Circular Bioeconomy.



"To Jews and Sarracens we grant the same guarantees because we do not want innocent people to be persecuted only because Jews and Muslims" (Frederick II, constitution of the Kingdom of the Two Sicilies, AD 1231)







The University of Torino





UNITO and its Incubator (**2i3t**) is one of the major Universities in Europe in the field of Bioeconomy and has selected **bioeconomy and circular economy** as key areas for research and education for their strategic repercussions at socio-economic level and disruptive innovation potential.

UNITO is strongly supporting the **MASTER BIOCIRCE** together with a number of initiatives in the field of Bioeconomy education, such as the **EIT FOOD** and the **PhD program in Innovation for the Circular Economy** and its industrial applications.





The University of Bologna

UNIBO is one of the leading Universities in Europe in the field of Bioeconomy research and has clearly identified the circular Bioeconomy as one of the key areas for future research and education. **UNIBO** has expended its initiatives into virtually all fields of the Bioeconomy. In this direction, it is strongly supporting the **MASTER BIOCIRCE** together with a number of initiatives in the field of Bioeconomy education, such as the European Bioeconomy University and several Bioeconomy education projects.











Bioeconomy in the Circular Economy – BIOCIRCE

www.masterbiocirce.com





Coordinating Scientific Committee:

- Giovanni Sannia, University of Napoli Federico II, President
- Paola Branduardi, University of Milano-Bicocca
- Davide Viaggi, University of Bologna
- Giovanna Cristina Varese, University of Torino
- Andrea Di Lemma, PTP Science Park
- Massimiliano Tellini, Intesa Sanpaolo Spa
- Giulia Gregori, Novamont Spa
- Pasquale Granata, GFBiochemicals Italy Spa
- Lucia Gardossi, CLUSTER SPRING and University of Trieste
- Emanuele Marconi, CLUSTER CLAN and University of Molise

The program welcomes students from different backgrounds:

- Graduate scientists who want to pursue a career outside the lab;
- Social and/or business graduates who want to develop their interests in life science innovation;
- People already working in biotechnology related fields.

The program includes **four compulsory modules** (5 Credits each) given by the four participating Universities (modules cover relevant scientific topics as well as economic and legal issues) and a **6- months stage** in one company or institution.

Application Requirements:

The selection is based on:

- Evaluation of Curriculum Vitae et Studiorum
- Evaluation of any relevant title and certification
- A cover letter outlining applicant's goals and objectives









PTP SCIENCE PARK







The Master's program offers an extensive training program for **professionals interested in working within the bio-based goods and services industry**.

The program allows to go in depth in all the aspects related to the production and marketing sides of bio-based products, whilst using the latest technology.

First edition of BIOCIRCE started on January 2017





Aim of the Master:

Studying the entire value chain for bio-based products giving to professionals the opportunity to deal with the environmental, social and economic dimensions of bio-economy from micro and macro level perspectives, including innovation, institutions and policies.

The program includes **four compulsory modules** (5 Credits each) given by the four participating Universities. Each module envisages teaching on scientific topics by staff members of the participating Universities, whilst Economic and regulatory aspects, as well as specific case studies, are covered by members of participating companies and associations.

Students are required to attend **4 weeks full-time lessons**, each one taught in a different University, and a **6-months stage in one company or institution**.





Bioeconomy in the Circular Economy - BIOCIRCE









BIOCIRCE signed, on **October the 4th 2019** a Memorandum of Understanding with the **Irish Bioeconomy Foundation**



BIOECONOMY IRELAND











"We need to worry about the new generations and what we will leave them"

Raul Gardini



In **2020** BIOCIRCE established an agreement with The **Raul Gardini Foundation** to fund annual scholarships for the most deserving students of the Master.





The Raul Gardini Foundation (<u>https://fondazioneraulgardini.org/</u>), promotes research and development of green chemistry and bioeconomy, educates in environmental sustainability, and promotes the scientific and cultural training of young people. Raul Gardini (1933-1993), an entrepreneur, pioneer and reference figure for the Bioeconomy worldwide.







Novamont is an Italian company, international leader in the bioplastics sector and in the development of biochemical.



Every year, since 2021, **Novamont** funds an annual scholarship for the most deserving student of the Master.

"Through a new **sustainable development model**, we promote the transition from a product economy to a **system economy**, relying on the valorization of local areas and on products that can redesign entire application sectors, reducing the costs of environmental and social externalities."





BIOCIRCE supported the organization of four Editions (2019-2022) of the:

MEDITERRANEAN SUMMER SCHOOL FOR SUSTAINABLE DEVELOPMENT AND BIOECONOMY

THESSALONIKI GREECE















A survey of students graduated in the first three editions of Master BIOCIRCE revealed that:









Bioeconomy in the Circular Economy

www.masterbiocirce.com









Bioeconomy in the Circular Economy - BIOCIRCE

On December the 11th 2017 there was the first graduation ceremony of the students of the "Bioeconomy in the Circular Economy" Master.

The official ceremony was chaired by Professor Cristina Messa, Rector of the University of Milano-Bicocca.









Italiadecide prize

The master BIOCIRCE received, on February the 12th 2018, at the Italian Parliament, from the President of the Italian Republic, the "Italiadecide" (Italy-decides) prize for teaching innovation.

The price has been awarded to the initiative of four Italian universities from North to South (University of Torino, University of Milano Bicocca, University of Bologna and University of Napoli Federico II), with the support of three of the main Italian bioeconomy players (Novamont, GFBiochemicals and Science Park of Lodi) and the Italian leading banking Group Intesa Sanpaolo, which is the only financial global partner of the Ellen McArthur Foundation.







Learning from the planned learning outcomes and curriculum of Educational programs aimed at Bioeconomy study

