STEM curriculum: Technical Electives

General rules:

- **Credits** dedicated to electives in year 2 **can not** be anticipated to year 1
- However, **elective courses** which cannot be attended in **year 1 can be attended in year 2**

STEM curriculum: Technical Electives

Hints:

- ***Do not "rush" to attend electives as early as possible: give priority to required courses (both in attending classes and in time dedicated e.g. to homework)***
- ***Be sure that timetable allows you to attend selected electives***
- ***Distribute evenly the electives between the two years and the two terms in the year - avoid to concentrate them in a single term***
- ***What you can not attend in year 1 can be attended in year 2***

STEM curriculum: Technical Electives

- Select the electives of your interest among the list provided in the following
- Check course content and exam mode carefully
- Check prerequisites and suggested year for attendance: contact the instructor to check if you can be admitted to the course
- Start attending the course
- Each year around February 15th and October 15th you will be required to formally select electives by an online application (study plan)
- Selected electives can be changed by the same procecure
- Selecting electives outside the suggested list is possible, but the program board should approve them: check preliminarily with Director of Studies

STEM International Curriculum
Elective Labs

(12 credits in year 1, up to 12 credits in year 2)

"Activities" that can be done in the 1st or 2nd year

2) Attività formative a scelta/Elective courses (6 CFU)

Choose 6 credits among the following courses:

		PERIOD	TYPE	CFU
81635	Internship for Master Thesis Preparation	2	E	6
69687	Research Project A	2	E	6
84551	INTERNSHIP ABROAD FOR PREPARATION OF THE FINAL EXAMINATION	E	E	6

3) Altre attività formative/Elective courses (12 CFU)

Choose 12 credits among the following courses:

		PERIOD	TYPE	CFU
78663	English Language Skills	1	F	3
78661	Italian Language and Culture	1	F	3
78652	Laboratory of Thermodinamic Simulation	1	F	3
78653	Laboratory of Advanced Process Simulation	1	F	3
78654	Laboratoty of Industrial and Enviromental Biotechnologies	1	F	3
78648	"Laboratory of Molecular Design and MaterialSimulation"	2	F	3
73506	Laboratory Of Industrial Safety M	2	F	3
73505	Laboratory Of Materials Characterization M	2	F	3
78650	Laboratory of Photocatalysis	2	F	3
73507	Transport Phenomena Laboratory M	2	F	3

STEM International Curriculum Second Year – Electives

RAVENNA CAMPUS (MAX LIMIT 18 CFU)

		PERIOD	TYPE	SSD	CFU
78494	Modelling of Offshore Structures	1	D	ICAR/08	6
78640	Monitoring and Positioning in Off-Shore Engineering	1	D	ICAR/06	6
78491	Design of Offshore Structures and Foundations - Not available for the year 2018/2019	2	D	ICAR/09	9
75385	Internship	2	D		6
81510	Laboratory of Offshore Operations	2	D		6
78724	Ocean and Coastal Engineering	2	D	ICAR/01	6
81511	Project Management In Offshore Activities	2	D	ING-IND/35	6

RISORGIMENTO CAMPUS - BOLOGNA (MAX LIMIT 18 CFU)

		PERIOD	TYPE	SSD	CFU
[redacted]					
73577	Computational Mechanics M	2	D	ICAR/08	6
84200	PHYSICS OF SEMICONDUCTOR DEVICES AND MEMORIES M - Not available for the year 2018/2019	2	D	ING-INF/01	6

TERRACINI CAMPUS - BOLOGNA (MAX LIMIT 18 CFU)

		PERIOD	TYPE	SSD	CFU
78663	English Language Skills	1	D		3
78661	Italian Language and Culture	1	D		3
78652	Laboratory of Thermodinamic Simulation	1	D		3
78653	Laboratory of Advanced Process Simulation	1	D		3
78654	Laboratoty of Industrial and Enviromental Biotechnologies	1	D		3
73578	Petroleum Geosystem M - Not available for the year 2018/2019	1	D	ING-IND/30	6
78648	"Laboratory of Molecular Design and MaterialSimulation"	2	D		3
84199	ADVANCED TRANSPORT PHENOMENA IN POLYMERS AND COMPOSITES M - Not available for the year 2018/2019	2	D	ING-IND/24	6
69996	Industrial Ecology M	2	D	ING-IND/25	6
73506	Laboratory Of Industrial Safety M	2	D		3
73505	Laboratory Of Materials Characterization M	2	D		3
78650	Laboratory of Photocatalysis	2	D		3
73507	Transport Phenomena Laboratory M	2	D		3

Presentation of Elective Laboratories

(You need to select up to 4 of these labs - 12 credits - in year 1; you may select up to 4 laboratories in year 2 - 0 to 12 credits)

Master Program in Chemical and Process Engineering

Technical Electives

Curriculum: STEM - Sustainable chemical and biochemical Technologies for Energy and Materials

Course: **Laboratory of photocatalysis**

Semester: II

ECTS: 3

Suggested year to take the course: 2

Prerequisites: A basic knowledge on Chemical Reactor Engineering is suggested, Spreadsheet (Excel) skills

Instructor: Prof. Giovanni Camera-Roda

e-mail: giovanni.cameraroda@unibo.it

webpage: https://www.unibo.it/sitoweb/giovanni.cameraroda/en

M.Sc. Chemical and Process Engineering

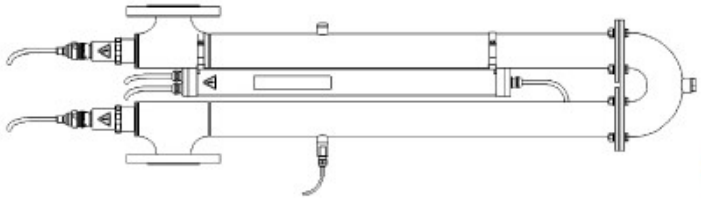
Electives

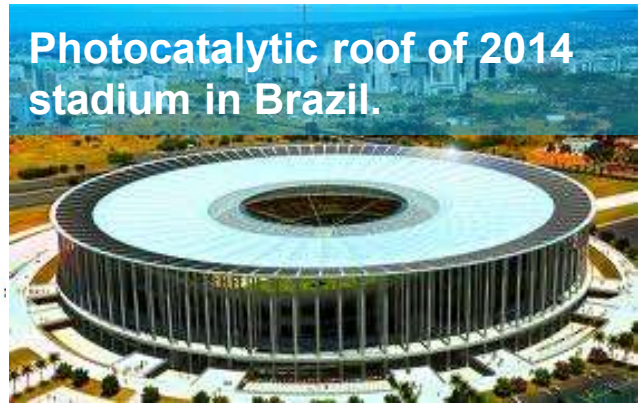
STEM curriculum - Terracini Campus

Course: Laboratory of photocatalysis

Photocatalytic processes are increasingly important for many applications ranging from detoxification and self-cleaning materials to green chemistry.

Photocatalytic water purifier





Purpose of the course: to give the students the basics of photocatalysis and the skill of operating on photocatalytic processes.

The course proposes a theoretical approach aimed to the knowledge of the process fundamentals and some laboratory experiences, where the principles are verified.

Master Program in Chemical and Process Engineering

Technical Electives

Curriculum: STEM - Sustainable chemical and biochemical Technologies for Energy and Materials

Course: **Laboratory of Industrial and Environmental Biotechnology**

Semester: I

ECTS: 3

Suggested year to take the course: 2

Prerequisites: background knowledge of biochemistry, microbiology and the main industrial and environmental biotechnology processes (course "Industrial and Environmental Biotechnology M" taken in parallel). Students having prior knowledge on these topics can attend with profit this course also during the 1st year.

Instructor: Prof. Giulio Zanaroli

e-mail: giulio.zanaroli@unibo.it

webpage: https://www.unibo.it/sitoweb/giulio.zanaroli/en

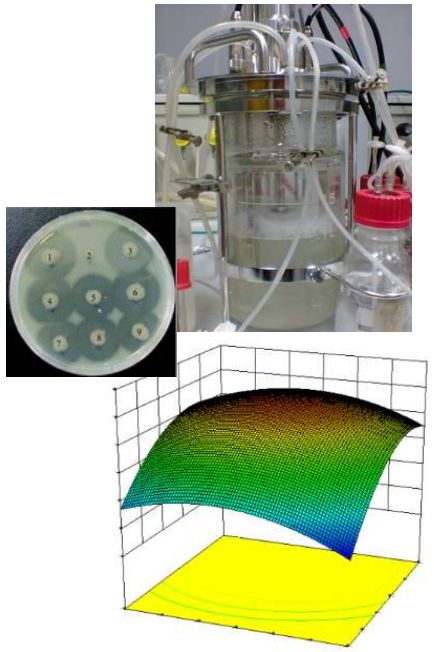
M.Sc. Chemical and Process Engineering

Electives

STEM curriculum - Terracini Campus

This course will provide the technical skills to grow and characterize microorganisms and to develop, monitor and optimize biotechnological processes of industrial or environmental interest on a lab scale:

- **Cultivation of microbes** and determination of the main growth kinetic parameters (Monod);
- **Screening and selection** (qualitative and quantitative approaches) **of microbes** producing hydrolytic enzymes of industrial interest;
- **Production of a microbial metabolite** of industrial interest (2,3-butanediol) in STR;
- **Bioremediation study of an oil-contaminated soil** in slurry reactors;
- **Principles of statistical design of experiments and examples** of its application in the optimization of biotechnological processes.



Students will be working in the lab independently or in groups of 2.

Each laboratory experience will be associated to a lecture introducing the experimental approach, the analytical methods and the analysis of results.

Final exam: report + oral discussion

Master Program in Chemical and Process Engineering

Technical Electives

Curriculum: STEM - Sustainable chemical and biochemical Technologies for Energy and Materials

Course: **Laboratory of Advanced Process Simulation**

Semester: I

ECTS: 3

Suggested year to take the course: 2

Prerequisites: Mass and energy balances, block diagrams and process flow diagrams, basics of process analysis, basic use of Hysys software.

Instructor: Prof. Giacomo Antonioni

e-mail: giacomo.antonioni@unibo.it

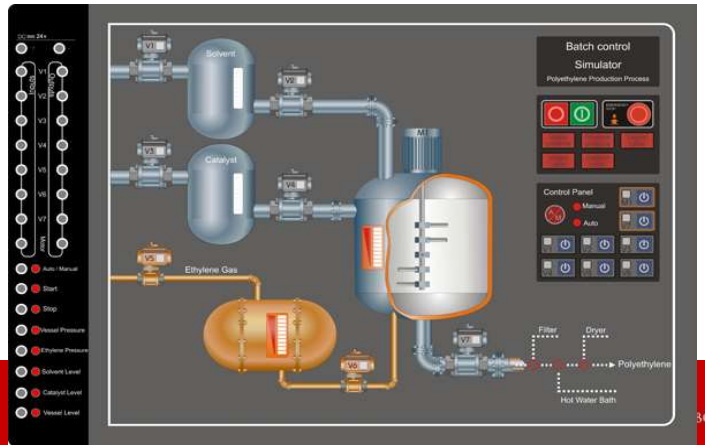
webpage: https://www.unibo.it/sitoweb/giacomo.antonioni/en

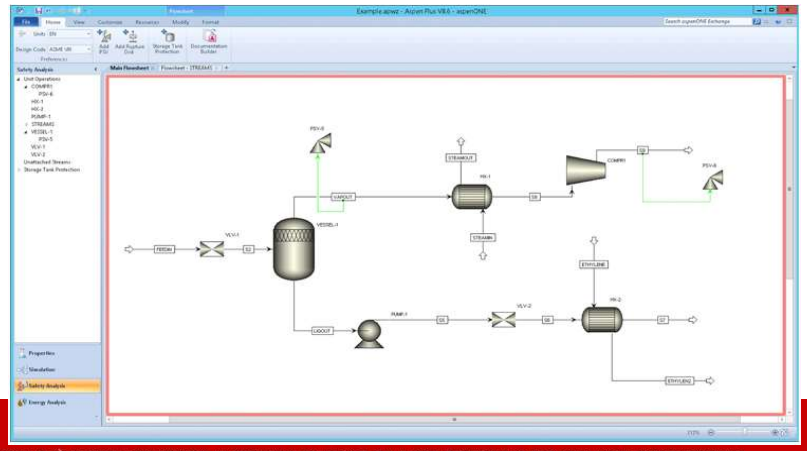
M.Sc. Chemical and Process Engineering

Electives

STEM curriculum - Terracini Campus

- ✓ Introduction to steady-state simulation as set of initial conditions for discontinuous operations and introduction to HYSYS software.
- ✓ Basic concepts of dynamic simulation: flow driven vs. pressure driven simulations
- ✓ Required design specifications that affect the time-dependent behavior of equipment items.
- ✓ Simulations of the transient of single unit operations.
- ✓ Simulations of the transient of small plant sections showing the interaction between different time-varying process variables
- ✓ Elaboration of a final project





Master Program in Chemical and Process Engineering

Technical Electives

Curriculum: STEM - Sustainable chemical and biochemical Technologies for Energy and Materials

Course: **Laboratory of Thermodynamic Simulations**

Semester: I

ECTS: 3

Suggested year to take the course: 1

Prerequisites: It is strongly suggested to take to course in parallel with Thermodynamics Of Energy And Materials (of after it).

Instructor: Prof. Marco Giacinti Baschetti

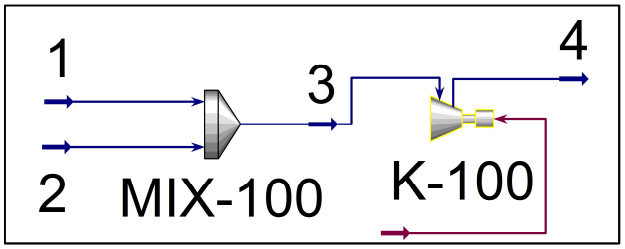
e-mail: marco.giacinti@unibo.it

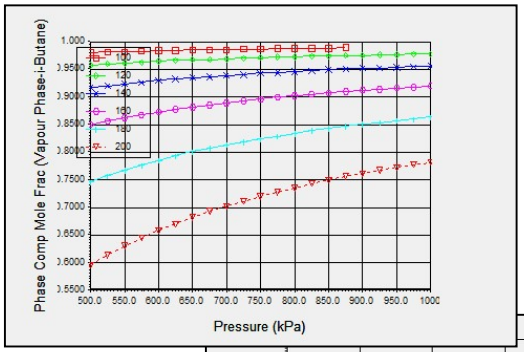
webpage: https://www.unibo.it/sitoweb/marco.giacinti/en

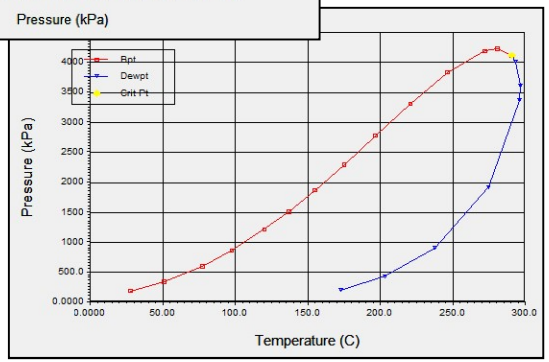
M.Sc. Chemical and Process Engineering

Electives

STEM curriculum - Terracini Campus







This course will focus on the analysis and use of thermodynamic models in process simulation. It will consist of:

- *An introduction to the evaluation of pure compounds and mixtures properties through the use of thermodynamic models such as:*
  - *Cubic Equation of State (EOS)*
  - *Activity coefficient models*
- *The analysis and use of the same models as implemented in commercial process simulation software (Aspen – Hysys)*

Assessment methods: discussion of the final report describing the problems discussed and solved during the course.

Master Program in Chemical and Process Engineering

Technical Electives

Curriculum: STEM - Sustainable chemical and biochemical Technologies for Energy and Materials

Course: **Transport Phenomena Laboratory**

Semester: II

ECTS: 3

Suggested year to take the course: either I or II

Prerequisites: A prior knowledge and understanding of fluidynamic and heat and mass transport is required to attend with profit.

Instructor: Prof. Matteo Minelli

e-mail: matteo.minelli@unibo.it

webpage: https://www.unibo.it/sitoweb/matteo.minelli/en

M.Sc. Chemical and Process Engineering

Electives

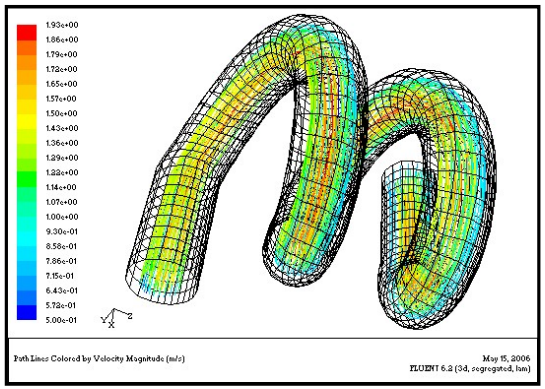
STEM curriculum - Terracini Campus

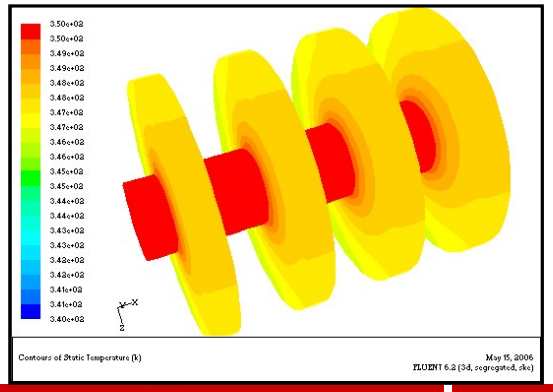
Analysis of **fluid mechanics** and **transport phenomena** processes by means of an appropriate software with a **computational approach**.

Course contents:

- ✓ understanding fundamental characteristics of Computational Fluid Dynamics (CFD) formulation of heat and momentum transport in fluid flows.
- ✓ knowledge of the relevant CFD procedures for the solution of a thermal and/or fluid mechanics problem.
- ✓ gaining experience in use of CFD software and in the interpretation of the results for the discussion of generalized transport laws.

Final exam: final project





Master Program in Chemical and Process Engineering

Technical Electives

Curriculum: STEM - Sustainable chemical and biochemical Technologies for Energy and Materials

Course: **Laboratory of Materials Characterization**

Semester: II

ECTS: 3

Suggested year to take the course: 2

Prerequisites: A prior knowledge and understanding of the physical and mechanical properties is required to attend with profit this Course.

This knowledge is obtained following the Course of Materials Characterization

Instructor: Prof. Stefania Manzi

e-mail: stefania.manzi4@unibo.it

webpage: https://www.unibo.it/sitoweb/stefania.manzi4/en

M.Sc. Chemical and Process Engineering

Electives

STEM curriculum - Terracini Campus

The laboratory provides the **know-how and the methodological tools** for the **characterization of materials** and their correct use in the engineering fields.

1) Tests for the investigation of the **nature and microstructure of materials** (e.g., ρ, WA, MIP, SEM + EDX, XRD).
2) Tests for the investigation of the **mechanical properties** of materials (e.g., strength test, impact test, hardness test).
3) Tests for the investigation of the **thermal properties** of materials (e.g., DSC, TGA).
4) **Ageing and durability tests** on materials with relation to their environment.

During the main experimental activities in the laboratory, students have to complete a sheet.

Final exam: oral discussion (pass/non pass)

Master Program in Chemical and Process Engineering

Technical Electives

Curriculum: STEM - Sustainable chemical and biochemical Technologies for Energy and Materials

Course: **Laboratory of Industrial Safety**

Semester: II

ECTS: 3

Suggested year to take the course: 1* or 2

Prerequisites: knowledge and understanding of the principles of hazard identification in process plants and quantitative risk assessment.

This knowledge is provided by the courses "Industrial Safety“ (*offered in the same semester of the 1st year)

Instructor: Prof. Alessandro Tugnoli

e-mail: a.tugnoli@unibo.it

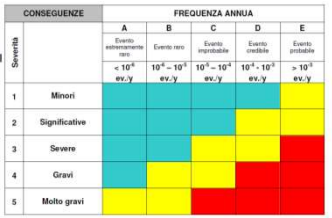
webpage: https://www.unibo.it/sitoweb/a.tugnoli/en

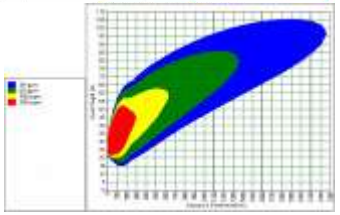
http://www.unibo.it/en/teaching/course-unit-catalogue/course-unit/2016/405298

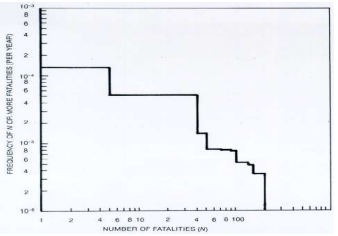
M.Sc. Chemical and Process Engineering

Electives

STEM curriculum - Terracini Campus



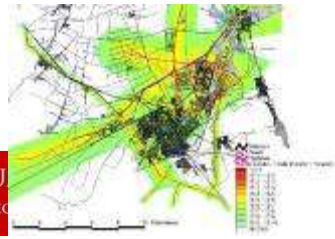




This course will provide students with the **practical application skills in loss prevention and risk analysis** for industrial processes.
The concepts learned in the Industrial Safety course will be applied by the **development of a project** in small groups.

1) Review of the QRA procedure. Assignment of a case-study.
2) Hazard identification (HazOp, fault tree and event tree analysis)
3) Frequency evaluation (parts count, bow-tie quantification)
4) Consequence and damage assessment (consequence and damage models, simulation by consequence modeling software)
5) Risk assessment (risk evaluation, possible mitigation measures)

Final exam: project + oral discussion



Master Program in Chemical and Process Engineering

Technical Electives

Curriculum: STEM - Sustainable chemical and biochemical Technologies for Energy and Materials

Course: **Laboratory Of Molecular Design and Materials Simulation**
LAMDMS

Semester: II
ECTS: 3

Suggested year to take the course: 1 or 2

Prerequisites: (suggested) *Termodinamica per l'Ingegneria Chimica M or Thermodynamics of Energy and Materials*

Instructor: Prof. Maria Grazia De Angelis

e-mail: grazia.deangelis@unibo.it

webpage: https://www.unibo.it/sitoweb/grazia.deangelis

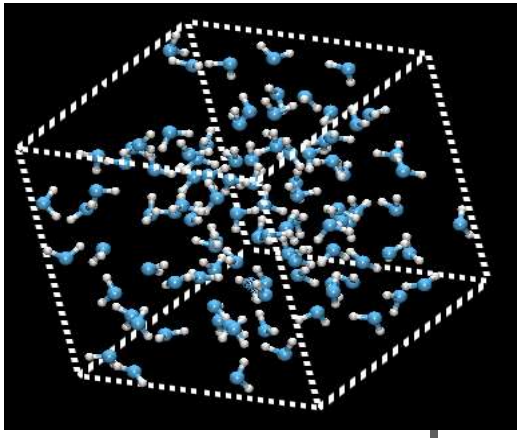
M.Sc. Chemical and Process Engineering

Electives

STEM curriculum - Terracini Campus

This course will provide students with the ability to **use a Molecular Dynamics Software to calculate properties of fluids and materials**.
The concepts of molecular thermodynamics will be applied by the **development of a project**.

1) Introduction to the molecular foundations of thermodynamics and how to evaluate macroscopic quantities from microscopic view: statistical mechanics laws.
2) Methodology: Molecular Dynamics (MD) methods.
3) Practice on a commercial software for building the molecules, the packing models and then run MD projects.
4) Evaluation of macroscopic properties



Final exam:

project + oral discussion