



**UNIVERSITÀ  
DEGLI STUDI  
DI TRIESTE**



Dipartimento di  
**Ingegneria  
e Architettura**

**MASTER DEGREE IN**

# **Materials and chemical engineering for nano, bio and sustainable technologies**

**academic year  
2026/2027**

Class LM-22 R (Chemical Engineering)  
and LM-53 (Materials Engineering)



# STUDY PROGRAMME

## 2026/2027 cohort

Students have the opportunity to pursue a personalized plan of study. There are two “curricula” with a total of **four main suggested study plans (“tracks”)**:

### ⇒ NANOTECHNOLOGY AND BIOTECHNOLOGY

- Track “Materials Engineering for Nanotechnology and Biotechnology”
- Track “Chemical Engineering for Nanotechnology and Biotechnology”

### ⇒ SUSTAINABLE INDUSTRIAL TECHNOLOGY

- Track “Materials Engineering for Sustainable Industrial Technology”
- Track “Chemical Engineering for Sustainable Industrial Technology”

## CURRICULUM NANOTECHNOLOGY AND BIOTECHNOLOGY

### TRACK: “MATERIALS ENGINEERING FOR NANOTECHNOLOGY AND BIOTECHNOLOGY”

#### 1<sup>st</sup> YEAR (60 ECTS)

| COURSE  | ECTS | DISC.     | TYPE |
|---|------|-----------|------|
| Molecular simulation                                      | 9    | ICHI-01/B | B    |
| Soft materials and release kinetics                       | 9    | ICHI-01/B | B    |
| Polymers and composites                                   | 9    |           |      |
| • Polymers and polymeric materials                        | 6    | IMAT-01/A | B    |
| • Composite materials: technology, recovery and recycling | 3    | IMAT-01/A | B    |
| Biomaterials and tissue engineering                       | 6    | IBIO-01/A | C    |
| Enzyme kinetics for nano and biotechnology                | 6    | IBIO-01/A | C    |
| Molecular biology for engineering and nano-bio laboratory | 12   |           |      |
| • Molecular biology for engineering                       | 6    | ICHI-01/B | B    |
| • Laboratory for nano-bio materials                       | 6    | ICHI-01/B | B    |
| Elective courses (*)                                      | 9    |           | D    |

#### 2<sup>nd</sup> YEAR (60 ECTS)

| COURSE  | ECTS | DISC.     | TYPE  |
|---|------|-----------|-------|
| Metallic materials and fracture mechanics   | 6    | IMAT-01/A | B     |
| Materials characterization and data analysis  | 9    |           |       |
| • Data Analysis   | 6    | CHEM-06/A | B/C** |
| • Spectroscopic methods for materials characterization                                      | 3    | IMAT-01/A | B     |
| Advanced materials science  | 9    |           |       |
| • Fundamentals of physics for materials   | 3    | PHYS-04/A | B/C** |
| • Radiation -matter interaction   | 3    | PHYS-03/A | B/C** |
| • Physical properties of materials and nanomaterials  | 3    | IMAT-01/A | B     |
| Nanomaterials for nano-bio technologies   | 6    | ICHI-01/B | B     |
| Ceramic materials and materials characterization laboratory                                 | 9    |           |       |
| • Ceramic materials   | 6    | IMAT-01/A | B     |
| • Materials characterization laboratory   | 3    | IMAT-01/A | B     |
| Elective courses (*)  | 6    |           |       |
| One activity between the following two:   |      |           |       |
| • <b>Italian language</b> (mandatory if the student does not have a B2 level in Italian) OR | 3    |           | F     |
| • <b>Internship</b>   | 3    |           | F     |
| Final thesis <sup>3</sup>   | 12   |           | E     |

## CURRICULUM NANOTECHNOLOGY AND BIOTECHNOLOGY

### TRACK: “CHEMICAL ENGINEERING FOR NANOTECHNOLOGY AND BIOTECHNOLOGY”

#### 1<sup>st</sup> YEAR (60 ECTS)

| COURSE  | ECTS | DISC.     | TYPE |
|---|------|-----------|------|
| Molecular simulation  | 9    | ICHI-01/B | B    |
| Soft materials and release kinetics   | 9    | ICHI-01/B | B    |
| Polymers and composites   | 9    |           |      |
| <ul style="list-style-type: none"> <li>Polymers and polymeric materials</li> </ul>                        | 6    | IMAT-01/A | B    |
| <ul style="list-style-type: none"> <li>Composite materials: technology, recovery and recycling</li> </ul> | 3    | IMAT-01/A | B    |
| Biomaterials and tissue engineering   | 6    | IBIO-01/A | C    |
| Enzyme kinetics for nano and biotechnology  | 6    | IBIO-01/A | C    |
| Molecular biology for engineering and nano-bio laboratory   | 12   |           |      |
| <ul style="list-style-type: none"> <li>Molecular biology for engineering</li> </ul>                       | 6    | ICHI-01/B | B    |
| <ul style="list-style-type: none"> <li>Laboratory for nano-bio materials</li> </ul>                       | 6    | ICHI-01/B | B    |
| Elective courses (*)  | 9    |           | D    |

#### 2<sup>nd</sup> YEAR (60 ECTS)

| COURSE  | ECTS | DISC.     | TYPE  |
|---|------|-----------|-------|
| Metallic materials and fracture mechanics   | 6    | IMAT-01/A | B     |
| Process design and control  | 9    | ICHI-01/B | B     |
| Chemical and biochemical reaction engineering   | 9    |           |       |
| <ul style="list-style-type: none"> <li>Chemical Reaction Engineering</li> </ul>   | 6    | ICHI-01/B | B     |
| <ul style="list-style-type: none"> <li>Biochemical Reactors</li> </ul>  | 3    | CHEM-04/A | B/C** |
| Nanomaterials for Nano-Bio Technologies   | 6    | ICHI-01/B | B     |
| Sustainable industrial chemistry  | 9    | CHEM-04/A | B/C** |
| Elective courses (*)  | 6    |           | D     |
| One activity between the following two:   |      |           |       |
| <ul style="list-style-type: none"> <li><b>Italian language</b> (mandatory if the student does not have a B2 level in Italian) OR</li> </ul> | 3    |           | F     |
| <ul style="list-style-type: none"> <li><b>Internship</b></li> </ul>   | 3    |           | F     |
| Final thesis <sup>3</sup>   | 12   |           | E     |

## CURRICULUM SUSTAINABLE INDUSTRIAL TECHNOLOGY

### TRACK: “MATERIAL ENGINEERING FOR SUSTAINABLE INDUSTRIAL TECHNOLOGY”

#### 1<sup>st</sup> YEAR (60 ECTS)

| COURSE   | ECTS | DISC.     | TYPE  |
|--|------|-----------|-------|
| Molecular simulation   | 9    | ICHI-01/B | B     |
| Soft materials and release kinetics  | 9    | ICHI-01/B | B     |
| Polymers and composites  | 9    |           |       |
| <ul style="list-style-type: none"> <li>Polymers and polymeric materials</li> </ul>                               | 6    | IMAT-01/A | B     |
| <ul style="list-style-type: none"> <li>Composite materials: technology, recovery and recycling</li> </ul>        | 3    | IMAT-01/A | B     |
| Materials, systems and critical raw materials for the energy transition  | 12   |           |       |
| <ul style="list-style-type: none"> <li>Materials for photovoltaics and energy transition technologies</li> </ul> | 3    | IMAT-01/A | B     |
| <ul style="list-style-type: none"> <li>Photovoltaic systems and energy management</li> </ul>                     | 3    | IJET-01/A | C     |
| <ul style="list-style-type: none"> <li>Strategic and critical raw materials</li> </ul>                           | 3    | CHEM-06/A | B/C** |
| <ul style="list-style-type: none"> <li>Substitution of critical materials</li> </ul>                             | 3    | IMAT-01/A | B     |
| Renewable Energy Technologies  | 6    | IIND-06/B | C     |
| Hydrogen and fuel cells  | 6    | IIND-06/A | C     |
| Elective courses (*)   | 9    |           | D     |

#### 2<sup>nd</sup> YEAR (60 ECTS)

| COURSE   | ECTS | DISC.     | TYPE  |
|--|------|-----------|-------|
| Metallic materials and fracture mechanics  | 6    | IMAT-01/A | B     |
| Materials characterization and data analysis   | 9    |           |       |
| <ul style="list-style-type: none"> <li>Data Analysis</li> </ul>  | 6    | CHEM-06/A | B/C** |
| <ul style="list-style-type: none"> <li>Spectroscopic methods for materials characterization</li> </ul> | 3    | IMAT-01/A | B     |
| Advanced materials science   | 9    |           |       |
| <ul style="list-style-type: none"> <li>Fundamentals of physics for materials</li> </ul>                | 3    | PHYS-04/A | B/C** |
| <ul style="list-style-type: none"> <li>Radiation -matter interaction</li> </ul>                        | 3    | PHYS-03/A | B/C** |
| <ul style="list-style-type: none"> <li>Physical properties of materials and nanomaterials</li> </ul>   | 3    | IMAT-01/A | B     |
| Design for sustainability of products and processes  | 6    |           |       |
| <ul style="list-style-type: none"> <li>Design for sustainability of processes and LCA</li> </ul>       | 3    | ICHI-01/B | B     |
| <ul style="list-style-type: none"> <li>Sustainable materials: selection and design</li> </ul>          | 3    | IMAT-01/A | B     |
| Ceramic materials and materials characterization laboratory  | 9    |           |       |
| <ul style="list-style-type: none"> <li>Ceramic materials</li> </ul>                                    | 6    | IMAT-01/A | B     |
| <ul style="list-style-type: none"> <li>Materials characterization laboratory</li> </ul>                | 3    | IMAT-01/A | B     |
| Elective courses (*)   | 6    |           | D     |



|  |    |   |
|--|----|---|
| One activity between the following two:  |    |   |
| <ul style="list-style-type: none"> <li>• <b>Italian language</b> (mandatory if the student does not have a B2 level in Italian) OR</li> <li>• <b>Internship</b></li> </ul> | 3  | F |
| Final thesis <sup>3</sup>  | 12 | E |

## CURRICULUM SUSTAINABLE INDUSTRIAL TECHNOLOGY

### TRACK: “CHEMICAL ENGINEERING FOR SUSTAINABLE INDUSTRIAL TECHNOLOGY”

#### 1<sup>st</sup> YEAR (60 ECTS)

| COURSE   | ECTS             | DISC.  | TYPE                 |
|--|------------------|--|----------------------|
| Molecular simulation   | 9                | ICHI-01/B  | B                    |
| Soft materials and release kinetics  | 9                | ICHI-01/B  | B                    |
| Polymers and composites  | 9                |  |                      |
| <ul style="list-style-type: none"> <li>• Polymers and polymeric materials</li> <li>• Composite materials: technology, recovery and recycling</li> </ul>  | 6<br>3           | IMAT-01/A<br>IMAT-01/A                           | B<br>B               |
| Materials, systems and critical raw materials for the energy transition  | 12               |  |                      |
| <ul style="list-style-type: none"> <li>• Materials for photovoltaics and energy transition technologies</li> <li>• Photovoltaic systems and energy management</li> <li>• Strategic and critical raw materials</li> <li>• Substitution of critical materials</li> </ul> | 3<br>3<br>3<br>3 | IMAT-01/A<br>IIET-01/A<br>CHEM-06/A<br>IMAT-01/A | B<br>C<br>B/C**<br>B |
| Renewable Energy Technologies  | 6                | IIND-06/B  | C                    |
| Hydrogen and fuel cells  | 6                | IIND-06/A  | C                    |
| Elective courses (*)   | 9                |  | D                    |

#### 2<sup>nd</sup> YEAR (60 ECTS)

| COURSE  | ECTS   | DISC.                  | TYPE       |
|---|--------|------------------------|------------|
| Metallic materials and fracture mechanics   | 6      | IMAT-01/A              | B          |
| Process design and control  | 9      | ICHI-01/B              | B          |
| Chemical and biochemical reaction engineering   | 9      |                        |            |
| <ul style="list-style-type: none"> <li>• Chemical Reaction Engineering</li> <li>• Biochemical Reactors</li> </ul>   | 6<br>3 | ICHI-01/B<br>CHEM-04/A | B<br>B/C** |
| Design for sustainability of products and processes   | 6      |                        |            |
| <ul style="list-style-type: none"> <li>• Design for sustainability of processes and LCA</li> <li>• Sustainable materials: selection and design</li> </ul> | 3<br>3 | ICHI-01/B<br>IMAT-01/A | B<br>B     |
| Sustainable Industrial Chemistry  | 9      | CHEM-04/A              | B/C**      |
| Elective courses (*)  | 6      |                        | D          |

One activity between the following two:

|  |    |   |
|--|----|---|
| <ul style="list-style-type: none"> <li>• <b>Italian language</b> (mandatory if the student does not have a B2 level in Italian) OR</li> <li>• <b>Internship</b></li> </ul> | 3  | F |
| Final thesis <sup>3</sup>  | 12 | E |

(\*) In the study plan, the student must register for elective courses (TAF D). Courses listed in any of the tracks not selected by the student, as well as the ones listed in the group “Elective Courses” below require no specific approval as elective courses, i.e. students can add them directly through the online system “esse3”. The student can propose other elective courses, but they are subject to approval. The student cannot enroll in an elective course if s/he has already given the same or equivalent exam in previous courses of study.

### (\*) ELECTIVE COURSES (automatically approved)

| COURSE   | CFU | SSD       | TAF |
|--|-----|-----------|-----|
| Computational fluid dynamics and heat transfer                                       | 9   | IIND-07/A | D   |
| Elementi di termofluidodinamica per le macchine - IN ITALIAN                         | 9   | IIND-01/F | D   |
| La sicurezza ed igiene negli ambienti di lavoro - IN ITALIAN                         | 6   | IEGE-01/A | D   |
| Tecnologia meccanica - IN ITALIAN  | 6   | IIND-04/A | D   |
| Impianti di abbattimento delle emissioni - IN ITALIAN                                | 6   | IIND-05/A | D   |
| Modellazione solida - IN ITALIAN   | 3   | IIND-03/B | D   |
| Progettazione meccanica con materiali avanzati e additive manufacturing - IN ITALIAN | 6   | IIND-03/A | D   |
| Proprietà e applicazioni dei materiali con laboratorio - IN ITALIAN                  | 9   | IMAT-01/A | D   |
| Metallurgia e corrosione con laboratorio - IN ITALIAN                                | 9   | IMAT-01/A | D   |
| Meccanica applicata alle macchine - IN ITALIAN                                       | 6   | IIND-02/A | D   |
| Termodinamica - IN ITALIAN   | 9   | ICHI-01/B | D   |
| Ingegneria dei processi di separazione - IN ITALIAN                                  | 9   | ICHI-01/B | D   |
| Transport phenomena  | 9   | ICHI-01/B | D   |
| Scienza delle costruzioni - IN ITALIAN   | 9   | CEAR-06/A | D   |
| Fondamenti di fisica delle superfici - IN ITALIAN                                    | 6   | PHYS-03/A | D   |
| Energie rinnovabili – IN ITALIAN   | 6   | CHEM-04/A | D   |
| Polymers and polymeric materials   | 6   | IMAT-01/A | D   |
| Composite materials: technology, recovery and recycling                              | 3   | IMAT-01/A | D   |
| Molecular biology for engineering  | 6   | ICHI-01/B | D   |
| Laboratory for nano-bio materials  | 6   | ICHI-01/B | D   |
| Data Analysis  | 6   | CHEM-06/A | D   |
| Spectroscopic methods for materials characterization                                 | 3   | IMAT-01/A | D   |
| Materials for photovoltaics and energy transition technologies                       | 3   | IMAT-01/A | D   |
| Photovoltaic systems and energy management   | 3   | IJET-01/A | D   |
| Strategic and critical raw materials   | 3   | CHEM-06/A | D   |
| Substitution of critical materials   | 3   | IMAT-01/A | D   |
| Physics of materials and radiation -matter interaction                               | 6   | PHYS-03/A | D   |
| Physical properties of materials and nanomaterials                                   | 3   | IMAT-01/A | D   |



|  |   |           |   |
|--|---|-----------|---|
| Design for sustainability of processes and Life Cycle Assessment | 3 | ICHI-01/B | D |
| Sustainable materials: selection and design                      | 3 | IMAT-01/A | D |

## EVALUATION

The level of knowledge will be evaluated by oral and/or written exams, as detailed by each instructor in the syllabus and at the beginning of the course.

## IMPORTANT NOTES FOR THE STUDENT

The master degree (“Laurea magistrale”) in Materials and Chemical Engineering for Nano, Bio, and Sustainable Technologies is an **interclass degree** (“corso di Laurea interclasse”), i.e. it can be conferred in one of two different “degree classes” of the Italian system (“classi di laurea”): either Chemical Engineering (LM-22), or Materials Engineering (LM-53). **The student is required to choose the degree class before the beginning of the second year.**

Additional personalization beyond the proposed plans of study can be possible; in this case, students are required to consult with the coordinator in order to design a plan of study in line with the degree class selected and with the student’s inclination.

The “Final Thesis” consists of an original and independent work in the field of materials engineering and/or chemical engineering. It can take the form of an extensive analysis of the scientific literature on a current relevant topic, or a design project, or a research project based on experiments, theory, or computational simulation. The work can be carried out entirely at the University of Trieste and/or in collaboration with other universities, research centers, and industries – both domestic and international.

Courses are classified according to the “Type of Educational Activity” (“TAF”):

TAF B = characterizing courses

TAF C = complementary courses

TAF D = elective courses

TAF E = final thesis

TAF F = other educational activities

(\*\*) Courses marked as “TAF B/C” are “characterizing” for one class and “complementary” for the other.



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## **PROSPECTIVE STUDENT SUPPORT AND PUBLIC INFORMATION OFFICES**

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Main Building (Building A), right wing, ground floor  
Tel: + 39 040 347 3787  
[orientamento@units.it](mailto:orientamento@units.it)

## **COMPETENT OFFICES**

For further info on the degree programmes

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