UNIVERSITY OF TRIESTE
ACADEMIC AND TEACHING REGULATIONS
for students enrolled in the academic year 2024/25

Master's degree programme in Mechanical Engineering – LM-IN15

Art. 1 - Objective

1. These regulations define in detail the contents of the related General Regulations (*Ordinamento Didattico*) of the Master's degree programme in Mechanical Engineering, under art. 12, s. 1 of the Ministerial Decree no. 270/2004 on "Amendments to the regulation containing the rules concerning the teaching autonomy of universities".
2. The General Regulations and the organisation of the Master's degree are defined in respect of freedom of teaching and the rights and duties of lecturers and students.

Art. 2 - Contents of the Academic and Teaching Regulations

1. The Academic and Teaching Regulations define the implementation of the General Regulations of the degree course and its organisational aspects.
2. In accordance with art. 4, s. 2 of the Teaching Regulations of the University of Trieste, the Academic and Teaching Regulations define:
   a) the list of modules (and their scientific sector), divided by year and their partition into sub-modules, and other teaching activities;
   b) the method for carrying out laboratory and practical activities, and traineeships;
   c) the expected learning outcomes (see Annex F), the number of university credits (ECTS) and any prerequisites for modules and other teaching activities, all divided by year;
   d) the curricula available to students and, where necessary, how to present the individual study plan;
   e) the provisions on any compulsory attendance and/or any alternative learning plan for student workers and/or disabled people;
   f) the entry requirements, the procedures to verify them at enrolment and any provisions on preparatory and supplementary activities aimed at fulfilling a conditional advancement;
   g) the procedure for admission to the final examination and graduation;
   h) the procedure for verification of knowledge of the foreign language at the required level;
   i) the possible use of English as the teaching language for some modules.

Art. 3 - Structure and organisation of the Master's degree programme

The following documents and regulations set the organisation and management of the degree course:

- University Charter;
- Teaching Regulations of the University;
- General Regulations of the Master's degree;
- List of taught modules and other teaching activities;
- Annual Study Plan.

Art. 4 - General Regulations of the Master's degree programme

1. The General Regulations set the structure and organisation of the Master's degree programme. In particular, they contain:
   a) the name and the ministerial class to which it belongs;

b) the expected learning outcomes of the programme in agreement with the European qualification framework;
c) career opportunities in relation to the activities listed by ISTAT;
d) the plan of teaching activities in agreement with the provisions of the ministerial class to which the course belongs;
e) the number of ECTS of all teaching activities;
f) the entry requirements and the procedure to verify them at enrolment;
g) the method for carrying out the final examination and graduation;

2. The General Regulations can be found in the SUA (*Scheda Unica Annuale*) statement of the programme.

Art. 5 - Plan of teaching activities

1. The plan of teaching activities specifies:
a) the list of taught modules, their scientific sectors and other teaching activities;
b) the sub-modules into which a module may be potentially subdivided and their scientific sectors;
c) the number of ECTS of each module or teaching activity;
d) any progression rules between modules;

2. The plan of teaching activities can be found in the SUA statement of the programme.

Art. 6 - Annual study plan

The annual study plan is updated annually and can be found in Annex A that is reported also in the SUA statement of the programme.

Art. 7 – Admissions

In order to be ~~e~~nrolled students must meet specific curricular requirements and must be adequately prepared. Details can be found in Annex B.

Art. 8 – Award of the degree

1. In order to graduate a student will have to acquire 120 ECTS.
2. Given that each year conventionally corresponds to 60 ECTS, the duration of the programme is two years.
3. The degree can be awarded in less than two years should the student has acquired all 120 ECTS included in their study plan.

Art. 9 - Structure of the Master's degree programme

1. The Master's degree programme entails the following types of teaching activities:
a) core teaching activities (teaching activity of type B - TAF B);
b) teaching activities related to the core ones, also with reference to cross-disciplinary training (TAF C);
c) optional teaching activities (TAF D);
d) teaching activities related to the final examination and linguistic knowledge (TAF E);
e) teaching activities to improve linguistic knowledge, any traineeships, computer skills, telematic and relational skills, and all skills useful for the professional career (TAF F).

2. The number of ECTS assigned to each of the listed activities is specified in Annex A.

Art. 10 – Laboratory and practical activities, and traineeships

Such activities are promoted and coordinated by members of the Board of Studies. More details can be found in Annex C.

Art. 10bis - Foreign Languages

Verification of proficiency in spoken and written English, at least equivalent to level B2 of the Common European Framework of Reference for Language Proficiency, is part of the assessment of the applicant's personal preparation. This competence can be taken from the Curriculum studiorum or from an appropriate certificate issued by a qualified institution recognised as valid by the University. In all other cases, admission is verified by a test prepared by the University.

Art. 11 - Teaching activities preparing for the final examination

1. In agreement with its learning outcomes and assigned number of ECTS, the final examination is an extensive project or methodological work presented together with a report (Master's dissertation). The graduating students will have to prove through the dissertation that they master the topic, they can work independently, and they are capable of structuring the paper and communicating the work performed. They should demonstrate that they can learn and critically use tools and methods, which were not necessarily explained during the course, useful to carry out the thesis. The topic needs to be pertinent to the fields of interest of Mechanical Engineering and it will be agreed with a supervisor of the university. The thesis can be related to the traineeship, and will be developed with the supervision of an academic staff (supervisor) and, if necessary, with the help of co-supervisors; the latter may be an academic staff or an external expert, especially if the dissertation is written during a traineeship to the premises of an external partner (either a company or an institution other than the University of Trieste).
2. The dissertation is presented and discussed during a pre-graduation examination in front of a Board nominated by the Head of Department. The Board consists of at least 3 members, one of which is the supervisor; others members can be either academic staff or external lecturers or experts. The committee assesses the content and the presentation and marks (maximum 30 marks).
3. The final mark of the Master's degree programme (a mark out of 110) is calculated through following formula:

$$L = \frac{110}{30}\ \frac{N_{cr} * E + n * P}{N_{cr} + n} + \Delta$$

with

$$\Delta = t + d + l + c \qquad \Delta = 0 \div 6$$

where

- N_{cr} sum of the number of ECTS of modules or teaching activities for which a mark is assigned;
- N number of ECTS of the final examination;
- E weighted average of the marks of modules or teaching activities for which a mark is assigned;
- P examination mark assigned by the Pre-graduation Board;
- Δ increment determined by:
  - t type of dissertation, with t = 0; 1; 2 (0: literature-review; 1: design, workshop; 2: research project);
  - d duration of enrolment in the programme, with d = 0; 1

(0: duration> 2.5 years (i.e. beyond March session of Year 2); 1: all other cases);

l value based on number of marks "30 *cum laude*", with *l* = 0; 1; 2
(0: no. "30 cum laude" < 4; 1: 4 ≤ no. "30 cum laude" < 8; 2: no. "30 cum laude"≥ 8);

c additional mark assigned by the Graduation Board, with c = 0; 1.

The final mark *L* is rounded off (e.g. 107.49 becomes 107 and 107.50 becomes 108).
4. The number of ECTS assigned to the final examination is specified in Annex A.

Art. 12 - Examination progression
1. In order to guarantee an appropriate teaching and learning path, the progression between examinations must be respected in accordance with the Teaching Regulations of the University.
2. The list of progression of examinations can be found in Annex D.

Art. 13 - Specific curricula
1. Within the programme, modules and teaching activities can be combined to offer specific curricula and to fulfil different cultural or professional needs.
2. Any specific curricula can be found in Annex A.

Art. 14 - Submission of an individual study plan
1. As an alternative to the regular procedure, a student can present an individual study plan for each academic year which includes from a minimum of 48 to a maximum of 84 ECTS, including those foreseen in the study plan of the student in the previous year and not yet acquired, with the constraint that the number of ECTS corresponding to modules or other teaching activities for which attendance has yet to be acquired should not exceed 60.
2. The Board of Studies may allow students to replace their modules with other modules offered from the University of Trieste or from other programmes of foreign Universities (either Bachelor's or Master's degrees) based on the coherence with the expected learning outcomes of the programme and the number of ECTS.

Art. 15 - Assessment
1. *Criteria for the arrangement of examination boards.* The examination board consists of two members: the module leader and another expert that can be either an academic staff or an expert of the subject. Non-academic staff experts are authorised by the Departmental Council. If the module is composed of two or more sub-modules with different leaders, they all must be part of the examination board.
2. *Assessment of taught modules and other teaching activities.* Assessment can take place with either ongoing tests or a final test to be held at the end of the module or activity.
3. Recording of the mark for examination composed of multiple tests. When an examination is composed of multiple tests, recording of the mark is performed only when the final mark is available.
4. Rules for repeating failed examinations during the same academic year. Students can repeat a failed examination in all the exam sessions of the academic calendar.

Art. 16 - Mandatory attendance
Attendance is not mandatory with the exception of any mandatory activities specified for each course.

Art. 17
Abrogated.

Art. 18 - Criteria for recording ECTS for activities and skills obtained prior to the enrolment
The Board of Studies can recognise a number of ECTS for activities performed or skills obtained prior to the enrolment to the Master's degree, if such activities are deemed coherent with the teaching activities and the expected learning outcomes of the programme as well as the duration, as specified in Annex E.

Art. 19 - Minimum number of ECTS to be acquired by the student in an established lapse
The Board of Studies may authorize, with explicit and motivated resolution, those students who in the previous academic year have demonstrated a particularly high academic performance, to include in their study plan a number of ECTS, corresponding to educational activities not yet attended, greater than 60, but in any case not greater than 84.
In formulating their study plan, the student must give priority to the courses and other educational-training activities which, in the official study plan of the Course, are proposed immediately downstream of those already present in their previous study plan. approved, unless explicitly decided by the Board of Studies following a reasoned request by the student.
The possibility for the student to enroll conditionally and to be able to acquire the missing credits in the extraordinary February session remains unchanged.

Art. 20 - Nature of these Regulations
These Regulations are defined as Academic and Teaching Regulations under art. 12 of the Ministerial Decree no. 270/2004.

Annexes
Ann. A: Annual study plan
Ann. B: Entry requirements
Ann. C: Traineeships
Ann. D: Progression rules
Ann. E: Recognition of previously-acquired skills or qualifications
Ann. F: Learning outcomes and teaching activities: tuning matrix

ANNEX A

MASTER'S DEGREE IN

MECHANICAL ENGINEERING

CLASS LM-33

for students enrolling in the 1st year of the academic year 2024-2025

The Master's Degree in Mechanical Engineering provides two curricula:

- MECHANICAL DESIGN AND PROTOTYPING
- ENERGY AND SUSTAINABILITY

The courses are classified according to the type of training activity (TAF):
A = basic teaching activities
B = core teaching activities
C = similar/complementary teaching activities
D = elective/optional teaching activities chosen by the student
E = final examination
F = other activities

The courses are taught in Italian, except where otherwise noted.

MECHANICAL DESIGN AND PROTOTYPING Curriculum				
1st year (54 CFU)				
Course	*Modules*	*Sector*	*TAF*	*CFU*
Machine design		ING-IND/14	B	9
Fluid dynamics		ING-IND/06	C	9
Vibration mechanics		ING-IND/13	B	9
Computational Fluid Dynamics and Heat Transfer (in English)	Introduction to Computational Fluid Dynamics	ING-IND/10	B	3
	Computational Methods for Fluid Dynamics and Heat Transfer	ING-IND/10	B	6
Integrated CAD/CAE mechanical design		ING-IND/15	B	6
Principles of electric actuation		ING-IND/32	C	6
Elective educational activities chosen by the student			D	6
2nd year (66 CFU)				
Course	*Modules*	*Sector*	*TAF*	*CFU*
Fundamentals and methods for design		ING-IND/08	B	9
Mechanical plants		ING-IND/17	B	9
Machinery project		ING-IND/08	B	9
Mechanical design with advanced materials and additive manufacturing		ING-IND/14	B	6
Robotics (in English)		ING-IND/13	B	6
Health and safety at the workplace		ING-IND/35	F	6
Elective educational activities chosen by the student			D	6
Internship			F	6
Final examination			E	12

In the Study Plan of the MECHANICAL DESIGN AND PROTOTYPING curriculum there are some Elective educational activities chosen by the student (TAF D). The choice of these modules is free, but it must be coherent with the educational project. Coherence will be assessed case-by-case by the Board of Studies of Mechanical Engineering.

The approval will be automatic if the modules are chosen among those shown in the following table:

ELECTIVE COURSES of MECHANICAL DESIGN AND PROTOTYPING Curriculum			
Course	*Sector*	*TAF*	*CFU*
Buildings HVAC Systems (in English)	ING-IND/11	D	6
Economic evaluation of plans and projects	ING-IND/17	D	6
Elements of Fluid machinery and Energy Systems (in English)	ING-IND/09	D	6
Emission abatement systems	ING-IND/17	D	6
Hydrogen and fuel cells (in English)	ING-IND/08	D	6
Industrial energy management (in English)	ING-IND/08	D	6
Integrated systems of management of safety and hygiene in the workplace	ING-IND/35	D	6
Maintenance and simulation of industrial plants	ING-IND/17	D	6
Marine Engineering	ING-IND/02	D	9
Mechanical, thermal and testing measurements	ING-IND/08	D	6
Metallurgy and corrosion	ING-IND/22	D	9
Mobile robots (in English)	ING-IND/13	D	6
Multidisciplinary analysis, design and optimization of complex systems	ING-IND/08	D	3
Naval Architecture and Ship Technology Laboratory	ING-IND/01	D	6
Production planning and control (*)	ING-IND/16	D	6
Renewable energy technologies (in English)	ING-IND/09	D	6
Solid modeling	ING-IND/15	D	3

(*) Only if the course has been activated.

PREREQUISITES

The prerequisites indicated in the following table are recommended:

Course	Precedence
Mechanical plants	Fluid dynamics; Machine design
Machinery project	Fluid dynamics; Machine design
Fundamentals and methods for design	Fluid dynamics; Machine design; Integrated CAD/CAE mechanical design
Robotics	Vibration mechanics; Machine design
Mechanical design with advanced materials and additive manufacturing	Machine design; Integrated CAD/CAE mechanical design
Integrated systems of management of safety and hygiene in the workplace	Health and safety at the workplace
Multidisciplinary analysis, design and optimization of complex systems	Fundamentals and methods for design

ENERGY AND SUSTAINABILITY Curriculum				
1st year (54 CFU)				
Course	*Modules*	*Sector*	*TAF*	*CFU*
Machine design		ING-IND/14	B	9
Fluid dynamics		ING-IND/06	C	9
Vibration mechanics		ING-IND/13	B	9
Computational Fluid Dynamics and Heat Transfer (in English)	Introduction to Computational Fluid Dynamics	ING-IND/10	B	3
	Computational Methods for Fluid Dynamics and Heat Transfer	ING-IND/10	B	6
Buildings HVAC Systems (in English)		ING-IND/11	C	6
Mechanical, thermal and testing measurements		ING-IND/08	C	6
Elective educational activities chosen by the student			D	6
2nd year (66 CFU)				
Course	*Modules*	*Sector*	*TAF*	*CFU*
Fundamentals and methods for design		ING-IND/08	B	9
Mechanical plants		ING-IND/17	B	9
Machinery project		ING-IND/08	B	9
Industrial energy management (in English)		ING-IND/08	B	6
Renewable energy technologies (in English)		ING-IND/09	B	6
Health and safety at the workplace		ING-IND/35	F	6
Elective educational activities chosen by the student			D	6
Internship			F	6
Final examination			E	12

In the Study Plan of the ENERGY AND SUSTAINABILITY curriculum there are some Elective educational activities chosen by the student (TAF D). The choice of these modules is free, but it must be coherent with the educational project. Coherence will be assessed case-by-case by the Board of Studies of Mechanical Engineering.

The approval will be automatic if the modules are chosen among those shown in the following table:

ELECTIVE COURSES of ENERGY AND SUSTAINABILITY Curriculum			
Course	Sector	TAF	CFU
Economic evaluation of plans and projects	ING-IND/17	D	6
Elements of Fluid machinery and Energy Systems (in English)	ING-IND/09	D	6
Emission abatement systems	ING-IND/17	D	6
Hydrogen and fuel cells (in English)	ING-IND/08	D	6
Integrated CAD/CAE mechanical design	ING-IND/15	D	6
Integrated systems of management of safety and hygiene in the workplace	ING-IND/35	D	6
Maintenance and simulation of industrial plants	ING-IND/17	D	6
Marine Engineering	ING-IND/02	D	9
Mechanical design with advanced materials and additive manufacturing	ING-IND/14	D	6
Metallurgy and corrosion	ING-IND/22	D	9
Mobile robots (in English)	ING-IND/13	D	6
Multidisciplinary analysis, design and optimization of complex systems	ING-IND/08	D	3
Naval Architecture and Ship Technology Laboratory	ING-IND/01	D	6
Principles of electric actuation	ING-IND/32	D	6
Production planning and control (*)	ING-IND/16	D	6
Robotics (in English)	ING-IND/13	D	6
Solid modeling	ING-IND/15	D	3

(*) Only if the course has been activated.

PREREQUISITES

The prerequisites indicated in the following table are recommended:

Course	Precedence
Mechanical plants	Fluid dynamics; Machine design
Machinery project	Fluid dynamics; Machine design
Fundamentals and methods for design	Fluid dynamics; Machine design; Integrated CAD/CAE mechanical design
Robotics	Vibration mechanics; Machine design
Mechanical design with advanced materials and additive manufacturing	Machine design; Integrated CAD/CAE mechanical design
Integrated systems of management of safety and hygiene in the workplace	Health and safety at the workplace
Multidisciplinary analysis, design and optimization of complex systems	Fundamentals and methods for design

ANNEX B

Admission to the Master's Degree

Admission to the Master's Degree in Mechanical Engineering is subject to the possession of specific curricular requirements and adequate personal preparation. The access to the Master's Degree requires a knowledge level equivalent to that provided by the general educational objectives of the Degrees of the Italian Industrial Engineering Class (Class 10 of DM509/1999 and Class L-9 of DM270/2004).

To be admitted to the Master's Degree in Mechanical Engineering the candidate must have one of the following qualifications:

- University Degree or Diploma
- Specialist or Master's Degree
- Five-year Degree
- Degree obtained abroad which is equivalent to one of the previously mentioned qualifications.

In addition, the candidate must have a total of 30 ECTS in the scientific disciplinary areas MAT/03, MAT/05, FIS/01, CHIM/07, CHIM/03. In addition, the candidate must at least have the number of credits in the scientific-disciplinary sectors listed here:

SSD	ECTS
Language of the U.E. beyond Italian	3
ICAR/08 or ING-IND/14	6
ING-IND/08 or ING-IND/09	6
ING-IND/10 or ING-IND/11	6
ING-IND/13	6
ING-IND/15	4
ING-IND/16	4
ING-IND/31	4

Admission is automatic if, in addition to compliance with the curricular requirements, the graduation grade is greater than or equal to 90/110; otherwise the candidate is subject to a competency assessment by a Commission of Mechanical Engineering teachers. This assessment, at the discretion of the Commission, will be an oral interview and/or a written test. The assessment of the candidate’s competency always takes place if some curricular constraints are not completely satisfied; for example, if the candidate graduated in a university outside Italy.

ANNEX C

Laboratory, practical and internship activities.

The internship activity (scope F) - subject to the supervision of a tutor and appropriately documented - is approved (or not) by a commission composed by the tutor himself and another teacher. If the internship is approved, it'll allow the completion of the educational path in the amount of 3 CFU as indicated in the Study Plan. Therefore, votes aren't attributed to the activity itself. In the case of the student carries out the internship outside the university, in a Company, he/she must BEFORE the starting of the internship, call on the Didactic Secretariat of the Department of Engineering and Architecture that will issue an insurance cover and will provide for the stipulation of a special agreement.

ANNEX D

Prerequisites

For the purposes of an orderly conduct of the teaching and learning processes, the prerequisites between the teachings must be respected, as established in the Academic Guidelines of the University.
The list of prerequisites is shown in the Annex A concerning the Study Plan of these Academic Guidelines.

ANNEX E

General criteria for the recognition of credits acquired prior to enrollment in the Master's Degree

The Board of Studies decides, with the following methods, the recognition of educational credits:

- Credits related to professional skills and abilities: these will be recognized under F (other educational activities), for a maximum of 12 CFU.
- Credits related to post-secondary educational activities, to which the University of Trieste has been involved in the planning and realization of the project: these will be recognized under D (elective educational activities chosen by the student), for a maximum of 12 CFU.
- Credits already accrued following the transfer from another Study Course and/or from another University: these will be evaluated on a case-by-case by the Board of Studies, considering the coherence of the educational contents.
- Credits acquired prior to enrollment in the Study Course: these will be valued based on congruence of the didactic and/or educational activities followed with the educational objectives of the Master's Degree in Mechanical Engineering, and the correspondence of the related teaching loads.

ANNEX F

The tuning matrix, which contains the learning outcomes of the teaching activities, is displayed in the following pages.

RISULTATI DI APPRENDIMENTO ATTESI			I ANNO								
Aree di apprendimento	**Descrittori di Dublino**	**dettaglio descrittori**	**112MI Costruzione di macchine**	**002MI Fluido-dinamica**	**004MI La sicurezza ed igiene negli ambienti di lavoro**	**296MI Meccanica delle vibrazioni**	**005MI Termo-fluido-dinamica computazionale**	**Buildings HVAC Systems**	**113MI Misure meccaniche termiche e collaudi**	**Principi di attuazione elettrica**	**046MI Progettazione meccanica CAD/CAE integrata**
Area di apprendimento generica *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Conoscenza degli aspetti metodologici-operativi dell'ingegneria meccanica*	x		x	x	x	x		x	x
		Capacità critica nel seguire l'evoluzione scientifica, tecnica e normativa del settore meccanico	x		x	x	x	x		x	x
		Conoscere i criteri progettuali tecnico-scientifici e rispondenti a problemi di sicurezza, economia, ambientali ecc.	x		x			x		x	x
		Conoscere la struttura e proprietà dei materiali	x	x	x	x		x			
		Conoscere le tecniche e gli strumenti del disegno tecnico e meccanico	x			x		x			x
		Conoscere le problematiche di sicurezza e salubrità degli ambienti di lavoro			x	x		x		x	
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Interpretare e descrivere problemi di elevata difficoltà dell'ingegneria meccanica*	x	x		x	x				x
		Identificare soluzioni innovative e non convenzionali					x			x	
		Stabilire ipotesi di lavoro e limiti di validità delle metodologie ingegneristiche		x			x			x	x
		Valutare le prestazioni di componenti e sistemi in esercizio	x		x			x	x	x	x
		Utilizzare strumenti informatici per la modellazione, l'analisi strutturale e dinamica	x								x
		Condurre attività di sperimentazione e collaudo, utilizzando la necessaria strumentazione				x			x		
		Comprendere e interpretare le normativa di sicurezza	x		x	x		x			
		Valutare il contesto operativo sotto il profilo economico, ambientale ecc.			x			x		x	
Area di apprendimento energetica e sostenibilità *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Normativa sul risparmio energetico*						x			
		Criteri di valutazione dei processi energetici						x		x	
		Principi di funzionamento delle turbomacchine e dei motori alternativi a comb.interna									
		Ruolo delle risorse rinnovabili nel fabbisogno energetico						x		x	
		Fondamenti per l'utilizzo delle tecniche di CFD e dei metodi di simulazione multi-fisica		x	x		x				
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Progettare, dimensionare e ottimizzare impianti termotecnici*						x			
		Valutare e proporre soluzioni efficienti per la produzione di energia elettrica									
		Selezionare e dimensionare turbomacchine e motori a combustione interna									
		Utilizzare in modo efficiente risorse energetiche rinnovabili						x		x	
		Utilizzare metodologie di CFD per lo studio e l'analisi di problemi di moto dei fluidi					x				
Area di apprendimento progettazione e prototipazione meccanica *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Nozioni avanzate di meccanica dei materiali e delle strutture*	x								x
		Concetti base e metodologie per lo studio dei sistemi vibranti			x	x					
		Metodologie di ottimizzazione applicate alla progettazione				x				x	x
		Fondamenti per il corretto utilizzo delle moderne tecniche di CFD		x	x		x				
		Metodologie di progettazione meccanica CAD/CAE	x			x					x
		Metodologie avanzate di progettazione per additive manufacturing									
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Applicare metodologie avanzate per l'analisi strutturale di sistemi e componenti meccanici*	x			x					x
		Analizzare e verificare il comportamento dei sistemi vibranti				x					
		Ottimizzare sistemi, componenti e processi secondo molteplici aspetti			x		x	x			x
		Utilizzare metodologie di CFD per lo studio e l'analisi di problemi di moto dei fluidi					x				
		Utilizzare moderni strumenti CAD/CAE, modellatori solidi e di calcolo agli elementi finiti in ambito meccanico	x			x	x				x
Competenze trasversali *(quadro A4.c della SUA-CdS)*	**Autonomia di giudizio (making judgements)**	*Valutare correttamente l'efficacia, l'efficienza e l'opportunità delle scelte progettuali*			x	x	x	x		x	x
		Sapere stimare e valutare i costi e gli effetti ambientali, sociali e sulla sicurezza			x			x		x	
		Sapere valutare l'utilizzo di tecnologie, materiali, processi, metodi e procedure nei problemi progettuali			x			x		x	x
	Abilità comunicative (communication skills)	*Capacità di descrivere ed esporre problemi tecnici nel settore dell'ingegneria meccanica*	x		x	x	x	x		x	x
		Capacità di operare in team, sapendo relazionare ai membri e ai referenti			x	x	x	x	x	x	x
		Abilità di presentare le attività e i progetti a soggetti con competenze diverse	x		x	x	x	x	x	x	x
		Capacità di comunicare nel linguaggio tecnico, anche in lingua inglese	x	x	x	x	x	x		x	x
	Capacità di apprendere (learning skills)	*Apprendere autonomamente per adeguarsi all'innovazione tecnologica e all'evoluzione degli scenari tecnico-economici*	x		x	x	x	x		x	
		Apprendere per adattarsi a cambiamenti di attività, settore industriale o specializzazione	x		x			x		x	
		Approfondire autonomamente le conoscenze sullo stato dell'arte nel settore di interesse professionale	x		x	x	x	x		x	x

RISULTATI DI APPRENDIMENTO ATTESI			II ANNO						
Aree di apprendimento	**Descrittori di Dublino**	**dettaglio descrittori**	**297MI Fondamenti e metodi per la progettazione**	**114MI Impianti meccanici**	**116MI Progetto di macchine**	**Industrial energy management**	**Renewable Energy Technologies**	**230MI Progettazione meccanica con materiali avanzati e additive manufacturing**	**195MI Robotics**
Area di apprendimento generica *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Conoscenza degli aspetti metodologici-operativi dell'ingegneria meccanica*		x				x	x
		Capacità critica nel seguire l'evoluzione scientifica, tecnica e normativa del settore meccanico		x			x	x	
		Conoscere i criteri progettuali tecnico-scientifici e rispondenti a problemi di sicurezza, economia, ambientali ecc.		x				x	
		Conoscere la struttura e proprietà dei materiali						x	
		Conoscere le tecniche e gli strumenti del disegno tecnico e meccanico							
		Conoscere le problematiche di sicurezza e salubrità degli ambienti di lavoro		x				x	
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Interpretare e descrivere problemi di elevata difficoltà dell'ingegneria meccanica*		x				x	x
		Identificare soluzioni innovative e non convenzionali		x				x	
		Stabilire ipotesi di lavoro e limiti di validità delle metodologie ingegneristiche		x				x	x
		Valutare le prestazioni di componenti e sistemi in esercizio		x			x		x
		Utilizzare strumenti informatici per la modellazione, l'analisi strutturale e dinamica					x	x	x
		Condurre attività di sperimentazione e collaudo, utilizzando la necessaria strumentazione							
		Comprendere e interpretare le normativa di sicurezza		x				x	
		Valutare il contesto operativo sotto il profilo economico, ambientale ecc.		x			x	x	
Area di apprendimento energetica e sostenibilità *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Normativa sul risparmio energetico*							
		Criteri di valutazione dei processi energetici		x		x	x		
		Principi di funzionamento delle turbomacchine e dei motori alternativi a comb.interna				x			
		Ruolo delle risorse rinnovabili nel fabbisogno energetico				x	x		
		Fondamenti per l'utilizzo delle tecniche di CFD e dei metodi di simulazione multi-fisica							
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Progettare, dimensionare e ottimizzare impianti termotecnici*		x					
		Valutare e proporre soluzioni efficienti per la produzione di energia elettrica				x	x		
		Selezionare e dimensionare turbomacchine e motori a combustione interna							
		Utilizzare in modo efficiente risorse energetiche rinnovabili					x		
		Utilizzare metodologie di CFD per lo studio e l'analisi di problemi di moto dei fluidi							
Area di apprendimento progettazione e prototipazione meccanica *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Nozioni avanzate di meccanica dei materiali e delle strutture*						x	
		Concetti base e metodologie per lo studio dei sistemi vibranti							
		Metodologie di ottimizzazione applicate alla progettazione							
		Fondamenti per il corretto utilizzo delle moderne tecniche di CFD						x	
		Metodologie di progettazione meccanica CAD/CAE						x	
		Metodologie avanzate di progettazione per additive manufacturing						x	
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Applicare metodologie avanzate per l'analisi strutturale di sistemi e componenti meccanici*							x
		Analizzare e verificare il comportamento dei sistemi vibranti							
		Ottimizzare sistemi, componenti e processi secondo molteplici aspetti						x	
		Utilizzare metodologie di CFD per lo studio e l'analisi di problemi di moto dei fluidi							
		Utilizzare moderni strumenti CAD/CAE, modellatori solidi e di calcolo agli elementi finiti in ambito meccanico						x	
Competenze trasversali *(quadro A4.c della SUA-CdS)*	**Autonomia di giudizio (making judgements)**	*Valutare correttamente l'efficacia, l'efficienza e l'opportunità delle scelte progettuali*		x			x	x	x
		Sapere stimare e valutare i costi e gli effetti ambientali, sociali e sulla sicurezza		x		x		x	
		Sapere valutare l'utilizzo di tecnologie, materiali, processi, metodi e procedure nei problemi progettuali						x	
	Abilità comunicative (communication skills)	*Capacità di descrivere ed esporre problemi tecnici nel settore dell'ingegneria meccanica*		x			x	x	x
		Capacità di operare in team, sapendo relazionare ai membri e ai referenti		x			x	x	x
		Abilità di presentare le attività e i progetti a soggetti con competenze diverse		x				x	x
		Capacità di comunicare nel linguaggio tecnico, anche in lingua inglese		x				x	x
	Capacità di apprendere (learning skills)	*Apprendere autonomamente per adeguarsi all'innovazione tecnologica e all'evoluzione degli scenari tecnico-economici*		x				x	x
		Apprendere per adattarsi a cambiamenti di attività, settore industriale o specializzazione		x				x	x
		Approfondire autonomamente le conoscenze sullo stato dell'arte nel settore di interesse professionale		x			x	x	x

RISULTATI DI APPRENDIMENTO ATTESI			ALTRE ATTIVITA' E INSEGNAMENTI A SCELTA														
Aree di apprendimento	**Descrittori di Dublino**	**dettaglio descrittori**	**250MI Modellazione solida**	**Analisi multidisciplinare, progetto e ottimizzazione di sistemi complessi**	**Hydrogen and Fuel Cells**	**Manutenzione e simulazione degli impianti industriali**	**Mobile robots**	**045MI Programmazione e controllo della produzione**	**118MI Sistemi integrati di gestione della sicurezza e igiene nei luoghi di lavoro**	**281MI Valutazione economica dei piani e dei progetti**	**Elements of Fluid machinery and Energy Systems**	**241MI Impianti di abbattimento delle emissioni**		**258MI Tirocinio**	**259MI Lingua Inglese**	**PFINE Prova finale**
Area di apprendimento generica *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Conoscenza degli aspetti metodologici operativi dell'ingegneria meccanica*	x			x	x		x		x					
		Capacità critica nel seguire l'evoluzione scientifica, tecnica e normativa del settore meccanico				x		x	x	x						
		Conoscere i criteri progettuali tecnico-scientifici e rispondenti a problemi di sicurezza, economia, ambientali ecc.			x	x			x	x	x	x				
		Conoscere la struttura e proprietà dei materiali			x				x							
		Conoscere le tecniche e gli strumenti del disegno tecnico e meccanico	x													
		Conoscere le problematiche di sicurezza e salubrità degli ambienti di lavoro			x	x			x			x				
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Interpretare e descrivere problemi di elevata difficoltà dell'ingegneria meccanica*				x	x					x		x		x
		Identificare soluzioni innovative e non convenzionali										x				x
		Stabilire ipotesi di lavoro e limiti di validità delle metodologie ingegneristiche	x		x	x	x	x		x	x	x				x
		Valutare le prestazioni di componenti e sistemi in esercizio			x	x	x	x	x		x	x		x		
		Utilizzare strumenti informatici per la modellazione, l'analisi strutturale e dinamica	x		x		x				x			x		x
		Condurre attività di sperimentazione e collaudo, utilizzando la necessaria strumentazione			x							x		x		x
		Comprendere e interpretare le normativa di sicurezza			x				x			x		x		
		Valutare il contesto operativo sotto il profilo economico, ambientale ecc.			x	x		x	x	x		x		x		
Area di apprendimento energetica e sostenibilità *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Normativa sul risparmio energetico*														
		Criteri di valutazione dei processi energetici			x						x					
		Principi di funzionamento delle turbomacchine e dei motori alternativi a comb.interna									x					
		Ruolo delle risorse rinnovabili nel fabbisogno energetico			x						x					
		Fondamenti per l'utilizzo delle tecniche di CFD e dei metodi di simulazione multi-fisica							x							
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Progettare, dimensionare e ottimizzare impianti termotecnici*			x											
		Valutare e proporre soluzioni efficienti per la produzione di energia elettrica			x											
		Selezionare e dimensionare turbomacchine e motori a combustione interna									x					
		Utilizzare in modo efficiente risorse energetiche rinnovabili			x											
		Utilizzare metodologie di CFD per lo studio e l'analisi di problemi di moto dei fluidi														
Area di apprendimento progettazione e prototipazione meccanica *(quadro A4.b.2 della SUA-CdS)*	**Conoscenza e capacità di comprensione (knowledge and understanding)** insieme di fatti, principi, teorie e pratiche	*Nozioni avanzate di meccanica dei materiali e delle strutture*					x									
		Concetti base e metodologie per lo studio dei sistemi vibranti							x							
		Metodologie di ottimizzazione applicate alla progettazione	x													
		Fondamenti per il corretto utilizzo delle moderne tecniche di CFD							x							
		Metodologie di progettazione meccanica CAD/CAE														
		Metodologie avanzate di progettazione per additive manufacturing														
	Conoscenza e capacità di comprensione applicate (applying knowledge and understanding) azioni e procedimenti la cui padronanza è ritenuta indispensabile per applicare le conoscenze e risolvere determinati compiti.	*Applicare metodologie avanzate per l'analisi strutturale di sistemi e componenti meccanici*														
		Analizzare e verificare il comportamento dei sistemi vibranti						x								
		Ottimizzare sistemi, componenti e processi secondo molteplici aspetti						x	x							
		Utilizzare metodologie di CFD per lo studio e l'analisi di problemi di moto dei fluidi														
		Utilizzare moderni strumenti CAD/CAE, modellatori solidi e di calcolo agli elementi finiti in ambito meccanico	x													
Competenze trasversali *(quadro A4.c della SUA-CdS)*	**Autonomia di giudizio (making judgements)**	*Valutare correttamente l'efficacia, l'efficienza e l'opportunità delle scelte progettuali*			x	x	x	x	x	x		x				x
		Sapere stimare e valutare i costi e gli effetti ambientali, sociali e sulla sicurezza				x				x		x				x
		Sapere valutare l'utilizzo di tecnologie, materiali, processi, metodi e procedure nei problemi progettuali			x			x	x	x		x				x
	Abilità comunicative (communication skills)	*Capacità di descrivere ed esporre problemi tecnici nel settore dell'ingegneria meccanica*			x	x	x	x	x			x		x		x
		Capacità di operare in team, sapendo relazionare ai membri e ai referenti				x	x		x			x		x		
		Abilità di presentare le attività e i progetti a soggetti con competenze diverse				x	x	x	x	x		x		x		x
		Capacità di comunicare nel linguaggio tecnico, anche in lingua Inglese			x	x	x		x	x		x		x	x	x
	Capacità di apprendere (learning skills)	*Apprendere autonomamente per adeguarsi all'innovazione tecnologica e all'evoluzione degli scenari tecnico-economici*			x	x	x		x	x	x	x				x
		Apprendere per adattarsi a cambiamenti di attività, settore industriale o specializzazione				x	x	x	x	x		x				x
		Approfondire autonomamente le conoscenze sullo stato dell'arte nel settore di interesse professionale			x	x	x	x	x	x	x	x			x	x