Major	Mechanical Engineering		
Master's program	MECHANICS OF MATERIALS FOR ENGINEERING AND INTEGRITY OF STRUCTURES		
Master's Code	MAGIS		
Qualification awarded	**Master's degree in Mechanical Engineering**		
Program director	**Xavier COLIN (xavier.colin@ensam.eu)**		
Mode of study	*Level of qualification*	*Field of study*	*Language of study*
Full time	**Master ISCED 7**	**Engineering ISCED-F-07**	**English**
ECTS	*Campus*	*Length of programme*	*Specific arrangements for recognition of prior learning*
60	**Paris**	**End of September to end of February (courses) Early March to end of August (Master Thesis)**	**No**
Keywords	**Materials science – Engineering and solid mechanics – Innovative manufacturing processes – Metal, polymers and composites – Heterogeneous and architecture materials - Numerical methods – Artificial intelligence – Advanced experimental methods – Advanced Machining and its application – Casting and forge – Additive manufacturing – Life cycle analysis – Materials for eco-design – Multiphysical analysis and modelling – Fatigue and durability**		

Admission requirements

Type	Level	Way
English proficiency	**Level B2**	**Certificate**
Previous degree	**First year of Master of Science degree**	**Certificate of achievement**

Applicants interested in the MAGIS programme must follow the online procedure and adhere to the schedule.

https://artsetmetiers.fr/en/formation/master-admissions

Overall objectives

MAGIS is a second-year Master's program aimed at providing students with a deeper understanding of the fundamentals of materials science and engineering and solid mechanics, as well as a better knowledge of the relationships between the manufacturing processes, the material, its microstructure and its mechanical properties. To illustrate these concepts, the program draws on recent developments in this field, carefully selected from advanced industrial applications and innovative manufacturing technologies. The emphasis is on generic methods, based on fundamental principles and mechanisms, rather than on the specific characteristics of materials.

This general approach in solid mechanics applies to a wide variety of materials (ceramics/glasses, metals, polymers, composites) and gives a complete understanding of the mechanical design and sizing of industrial systems (transport vehicles, nuclear power-plants, etc.) under various and complex external loadings. Students are learned to scientific methodology, ranging from advanced experimental methods to modeling and simulation of the mechanical behavior of structures, through the analysis of the mechanisms involved throughout the material life cycle, including their couplings.

This approach is deployed along three different tracks: machining and simulation (MASI), metal processing and additive manufacturing (MPAM), and life cycle of polymers and composites (LCPC).

Program learning goals

The table below details the abilities to be acquired and the expected proficiency levels according to the following grading scale:

1) Lead an innovative approach in a disciplinary field that takes into account the complexity of the situation by using information that may be incomplete or seems to be contradictory
2) Lead a research project (design, fulfilment and management, evaluation, dissemination) that can mobilize multidisciplinary skills in a collaborative framework, and accept responsibilities
3) Adapt to different socio-professional and intercultural, but also national and international contexts
4) Update their knowledge in a specialized scientific field by performing a thorough literature review (state of the art)
5) Communicate clearly and concisely (by talk, poster, written report, etc.) in English in front of an audience of specialists and non-specialists.

Sets of expected abilities	***Expected abilities***	***Expected proficiency level***
		R&D
Disciplinary knowledge and reasoning	**1.1 Knowledge of underlying mathematics and science**	
	1.2 Core fundamental knowledge of engineering	**X**
	1.3 Advanced engineering fundamental knowledge, methods and tools	
Personal and professional skills attributes	**2.1 Analytical reasoning and problem solving**	
	2.2 Experimentation, investigation and knowledge discovery	**X**
	2.3 System thinking	
	2.4 Ethics, though and learning	
	2.5 Ethics, equity and other responsibilities	
Interpersonal skills: Teamwork and communication	**3.1 Teamwork**	
	3.2 Communications	
	3.3 Communications in foreign language	
Conceiving, Designing, implementing, operating, innovating and entrepreneurship in the context of Corporate Social Responsibility	**4.1 External, societal and environmental context**	
	4.2 Enterprise and business context	
	4.3 Conceiving, systems engineering and management	
	4.4 Designing	
	4.5 Implementing	
	4.6 Operating	**X**
	4.7 Leading engineering endeavours	
	4.8 Engineering entrepreneurship	

More specifically, the **key strengths** of the MAGIS programme are as follows:

Program structure

Study and assessment rules

Each module can be evaluated by means of tutorials, practical works, projects, reports, poster or oral presentations, and/or exams, and the assessment rules are explained at the beginning of the programme. Each module is evaluated between 0 and 20.

For all modules, the research project and the master thesis, to validate the ECTS, the final mark should be ≥ 10. There is no compensation between modules.
Resit exams are organized at the beginning of the second semester (at the end of March).

Graduation requirements

To be graduated, students need to comply with the following rules:

- Validate 30 ECTS during the first semester, with a final average ≥ 10 and no mark < 7.
- Validate 30 ECTS during the second semester, with a final average ≥ 10 and no mark < 7.

At the end of the MAGIS program, the final average is calculated from the average of two semesters, and different honours are awarded (highest honours, high honours, honours) only to students who have no mark < 10.

Careers of graduates and access to further studies

Depending on their results and professional expectations, graduate students can continue their professional careers as a:

- PhD student in industry (CIFRE) or in academia to further investigate and work on up-to-date scientific challenges and thus, become a recognized expert. This is a preliminary step to reach a position of researcher or professor in France or abroad.
- Positions in large companies or start-ups (researcher in R&D laboratory, mechanical design engineer, production workshop manager, project manager, consultant, head of R&D department, etc.) in many industrial fields (aeronautics and space, automotive, building and civil engineering, energy, electricity, nuclear, health, manufacturing, etc.).

Major	Mechanical Engineering		
Master's program	MECHANICS OF MATERIALS FOR ENGINEERING AND INTEGRITY OF STRUCTURES		
Master's Code	MAGIS-LCPC		
Qualification awarded	**Master's degree in Mechanical Engineering**		
Program director	**Prof. Xavier COLIN** (xavier.colin@ensam.eu)		
Mode of study	*Level of qualification*	*Field of study*	*Language of study*
Full Time	**Master Code ISCED 7**	**Engineering Code ISCED-F-07**	**English**
ECTS	*Campus*	*Length of programme*	*Specific arrangements for recognition of prior learning*
60	**Paris**	**1 year (from September to August)**	**Yes (VAE or VAP)**
Keywords	**Materials science – Engineering and solid mechanics – Innovative manufacturing processes – Metal, polymers and composites – Heterogeneous and architecture materials - Numerical methods – Artificial intelligence – Advanced experimental methods – Life cycle analysis – Materials for eco-design – Multiphysical analysis and modelling – Fatigue and durability**		

Admission requirements

Type	Level	Way
English proficiency	**Level B2**	**Certificate**
Previous degree	**First-year Master's degree (M1) at least, or equivalent, in Engineering**	**Certificate of achievement**

Applicants interested in the MAGIS program must follow the online procedure and adhere to the schedule.

https://artsetmetiers.fr/en/formation/master-admissions

Overall objectives

MAGIS is a second-year Master's program aimed at providing students with a deeper understanding of the fundamentals of materials science and engineering and solid mechanics, as well as a better knowledge of the relationships between the manufacturing processes, the material, its microstructure and its mechanical properties. To illustrate these concepts, the program draws on recent developments in this field, carefully selected from advanced industrial applications and innovative manufacturing technologies. The emphasis is on generic methods, based on fundamental principles and mechanisms, rather than on the specific characteristics of materials.

This general approach in solid mechanics applies to a wide variety of materials (ceramics/glasses, metals, polymers, composites) and gives a complete understanding of the mechanical design and sizing of industrial systems (transport vehicles, nuclear power-plants, etc.) under various and complex external loadings. Students are learned to scientific methodology, ranging from advanced experimental methods to modeling

and simulation of the mechanical behavior of structures, through the analysis of the mechanisms involved throughout the material life cycle, including their couplings.

The MAGIS-LCPC track deals more particularly with the life cycle of polymers and composite materials, from their manufacturing processing to their in-service performances (mainly their physical and mechanical properties), including their durability The issue of recycling these materials at the end of their life is also addressed. Particular attention is paid on bio-based and biodegradable materials, with a view to a eco-design and reduction of the carbon footprints.

Program learning goals

The table below details the skills to be acquired and the expected proficiency levels in accordance with the following targets:

1) To lead an innovative approach in a disciplinary field that takes into account the complexity of the situation by using information that may be incomplete or seems to be contradictory;
2) To lead a research project (design, fulfilment and management, dissemination) that can mobilize multidisciplinary skills in a collaborative framework and accept responsibilities;
3) To adapt to different socio-professional and intercultural, but also national and international contexts;
4) To update his knowledge in a specialized scientific field by performing a thorough literature review (state-of-the-art);
5) To communicate clearly and concisely (by talk, poster, written report, etc.) in English in front of an audience of specialists and non-specialists.

Sets of expected abilities	***Expected abilities***	***Expected proficiency level***
		R&D
Disciplinary knowledge and reasoning	**1.1 Knowledge of underlying mathematics and science**	**4**
	1.2 Core fundamental knowledge of engineering	**4**
	1.3 Advanced engineering fundamental knowledge, methods and tools	**4**
Personal and professional skills attributes	**2.1 Analytical reasoning and problem solving**	**4**
	2.2 Experimentation, investigation and knowledge discovery	**4**
	2.3 System thinking	**3**
	2.4 Ethics, though and learning	**4**
	2.5 Ethics, equity and other responsibilities	**4**
Interpersonal skills: Teamwork and communication	**3.1 Teamwork**	**4**
	3.2 Communications	**4**
	3.3 Communications in foreign language	**3**
Conceiving, Designing, implementing, operating, innovating and entrepreneurship in the context of Corporate Social Responsibility	**4.1 External, societal and environmental context**	**3**
	4.2 Enterprise and business context	**3**
	4.3 Conceiving, systems engineering and management	**3**
	4.4 Designing	**4**
	4.5 Implementing	**3**
	4.6 Operating	**3**
	4.7 Leading engineering endeavours	**4**
	4.8 Engineering entrepreneurship	**3**

More specifically, the **key strengths** of the MAGIS-LCPC program are as follows:

- It is held in the historical heart of Paris and in research laboratories in Paris areas (CMAT, FAST, LMPS, PIMM, SIMM, etc.);
- It is a joint program between several Parisian engineering schools: Arts et Métiers Institute of Technology, ENS-Paris-Saclay, CentraleSupélec, Mines-Paris and ESPCI-Paris;
- It involves several industrial partners which give conferences and offer research internships within their own research and development departments: AIRBUS, Air Liquide, CEA, CNES, EDF, ELANOVA, ONERA, RENAULT, SAFRAN, SNCF, etc.;
- Each year, about half of the promotion is made up of foreign students coming from partner universities or engineering schools in order to obtain a double Master's degree: Bauman Moscow State Technical University, ENSAM Casa, ENSAM Meknes, Iran University of Science and Technology, KIT Karlsruhe, Politechnico di Bari, Universidad del País Vasco, Universidad de Valencia, University of Guilan, University of Teheran, etc.;
- Students interact with internationally recognized academic staffs and are in regular contact with industry due to the large volume of research works performed by laboratories for industry.

Program structure

Learning outcomes are reached through a well-balanced training program that combines theoretical and practical learning sequences.

MAGIS-LCPC is a second-year Master's program that spreads over two semesters (Figure 1):

- **First semester (S3)**: From September to February
  This semester is composed of 5 general scientific modules, 4 specialized modules, a foreign language module (English for French and francophone students, French for foreign and non-francophone students), and a management module (recommended for ENSAM engineering students only), all dedicated to this program for a total of 30 ECTS.
  Second semester (S4): From February to August
  The second semester is dedicated to the research project followed by the Master thesis lasting (at least) 20 weeks for a total of 30 ECTS.
  The internship will be made in a research structure (i.e. university laboratory or company department) in France or abroad.

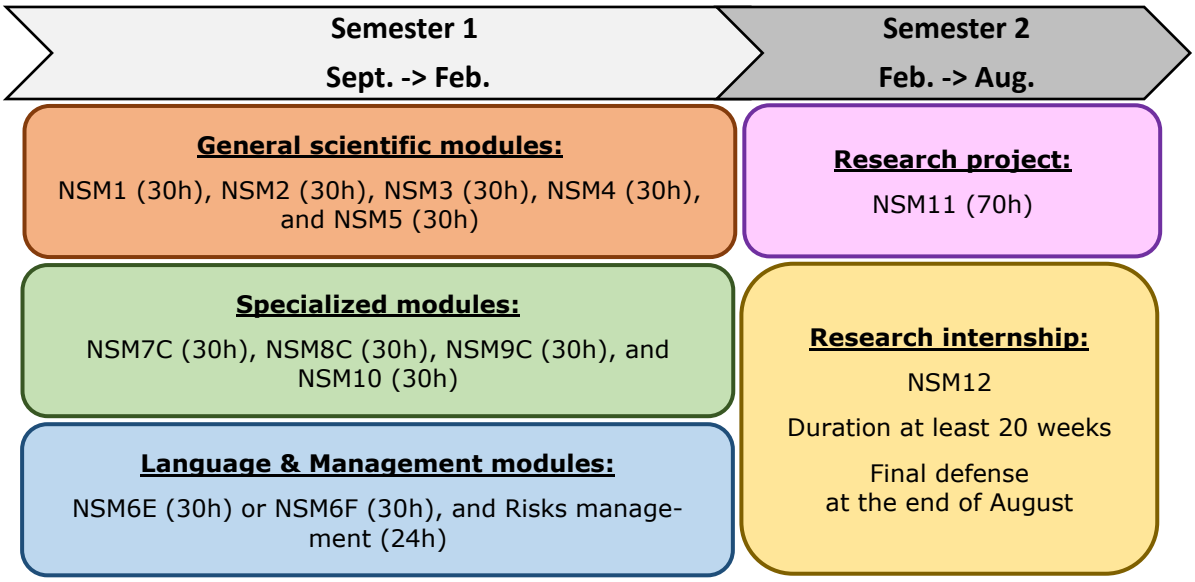

Figure 1: Structure of the MAGIS-LCPC program

Code	Title	Semester	ECTS	Hours	Compulsory/ Optional	Teaching modality
NSM1	Materials science	S3	3	30	Compulsory	Lectures/tutorials
NSM2	Materials and structure computation by finite element method	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM3	Artificial intelligence for mechanics of materials	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM4	Algorithmic modelling of multi-physical processes	S3	3	30	Compulsory	Lectures/project
NSM5	Solid mechanics of heterogeneous and architecture materials	S3	3	30	Compulsory	Lectures/tutorials/project
NSM6E	Scientific communication in foreign language	S3	3	30	Compulsory for French and francophone students	Lectures/project
NSM6F	Scientific communication in foreign language	S3	3	30	Compulsory for foreign and non-francophone students	Lectures/project
–	Risks management	S3	–	24	Recommended for engineering ENSAM students	Lectures/project
NSM7C	Processing of polymers and composites	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM8C	Mechanical behavior of polymers and composites	S3	3	30	Compulsory	Lectures/tutorials
NSM9C	Materials for eco-design	S3	3	30	Compulsory	Lectures/tutorials/project
NSM10	Impact of manufacturing processes on mechanical properties and durability	S3	3	30	Compulsory	Lectures/tutorials/project
NSM11	Research project	S4	6	70	Compulsory	Bibliographic study
NSM12	Master Thesis	S4	24	N/A	Compulsory	Research internship

Table 1: Detail of the modules of the MAGIS-LCPC track over the two semesters.

Study and assessment rules

Each module can be evaluated by means of tutorials, practical works, projects, reports, poster or oral presentations and/or exams and the assessment rules are explained at the beginning of the programme. Each module is evaluated between 0 and 20.
For all modules, the research project and the master thesis, to validate the ECTS, the final mark should be ≥ 10. There is no compensation between modules.
Resit exams are organized at the beginning of the second semester (at the end of March).

Graduation requirements

To be graduated, students need to comply with the following rules:

- Validate 30 ECTS during the first semester, with a final average ≥ 10 and no mark < 7.
- Validate 30 ECTS during the second semester, with a final average ≥ 10 and no mark < 7.

At the end of the MAGIS-LCPC program, the final average is calculated from the average of two semesters, and different honours are awarded (highest honours, high honours, honours) only to students who have no mark < 10.

Careers of graduates and access to further studies

Depending on their results and professional expectations, graduate students can continue their professional careers as a:

- PhD student in industry (CIFRE) or in academia to further investigate and work on up-to-date scientific challenges and thus, become a recognized expert. This is a preliminary step to reach a position of researcher or professor in France or abroad.
- Positions in large companies or start-ups (researcher in R&D laboratory, mechanical design engineer, production workshop manager, project manager, consultant, head of R&D department, etc.) in many industrial fields (aeronautics and space, automotive, building and civil engineering, energy, electricity, nuclear, health, manufacturing, etc.).

Major	Mechanical Engineering		
Master's program	MECHANICS OF MATERIALS FOR ENGINEERING AND INTEGRITY OF STRUCTURES		
Master's Code	MAGIS-MASI		
Qualification awarded	**Master's degree in Mechanical Engineering**		
Program director	**Prof. Xavier COLIN** (xavier.colin@ensam.eu)		
Mode of study	*Level of qualification*	*Field of study*	*Language of study*
Full Time	**Master Code ISCED 7**	**Engineering Code ISCED-F-07**	**English**
ECTS	*Campus*	*Length of programme*	*Specific arrangements for recognition of prior learning*
60	**Paris**	**1 year (from September to August)**	**Yes (VAE or VAP)**
Keywords	**Materials science – Engineering and solid mechanics – Innovative manufacturing processes – Metal, polymers and composites – Heterogeneous and architecture materials - Numerical methods – Artificial intelligence – Advanced experimental methods – Advanced machining and its application – Multiphysical analysis and modelling – Fatigue and durability**		

Admission requirements

Type	Level	Way
English proficiency	**Level B2**	**Certificate**
Previous degree	**First-year Master's degree (M1) at least, or equivalent, in Engineering**	**Certificate of achievement**

Applicants interested in the MAGIS program must follow the online procedure and adhere to the schedule.

https://artsetmetiers.fr/en/formation/master-admissions

Overall objectives

MAGIS is a second-year Master's program aimed at providing students with a deeper understanding of the fundamentals of materials science and engineering and solid mechanics, as well as a better knowledge of the relationships between the manufacturing processes, the material, its microstructure and its mechanical properties. To illustrate these concepts, the program draws on recent developments in this field, carefully selected from advanced industrial applications and innovative manufacturing technologies. The emphasis is on generic methods, based on fundamental principles and mechanisms, rather than on the specific characteristics of materials.

This general approach in solid mechanics applies to a wide variety of materials (ceramics/glasses, metals, polymers, composites) and gives a complete understanding of the mechanical design and sizing of industrial systems (transport vehicles, nuclear power-plants, etc.) under various and complex external loadings. Students are learned to scientific methodology, ranging from advanced experimental methods to modeling

and simulation of the mechanical behavior of structures, through the analysis of the mechanisms involved throughout the material life cycle, including their couplings.

The MAGIS-MASI track deals more particularly with the advanced machining of metallic materials using innovative techniques and intelligent control approaches (sensors and artificial intelligence), its applications and its multiphysical analysis and modelling.

Program learning goals

The table below details the skills to be acquired and the expected proficiency levels in accordance with the following targets:

1) To lead an innovative approach in a disciplinary field that takes into account the complexity of the situation by using information that may be incomplete or seems to be contradictory;
2) To lead a research project (design, fulfilment and management, dissemination) that can mobilize multidisciplinary skills in a collaborative framework and accept responsibilities;
3) To adapt to different socio-professional and intercultural, but also national and international contexts;
4) To update his knowledge in a specialized scientific field by performing a thorough literature review (state-of-the-art);
5) To communicate clearly and concisely (by talk, poster, written report, etc.) in English in front of an audience of specialists and non-specialists.

Sets of expected abilities	***Expected abilities***	***Expected proficiency level***
		R&D
Disciplinary knowledge and reasoning	**1.1 Knowledge of underlying mathematics and science**	**4**
	1.2 Core fundamental knowledge of engineering	**4**
	1.3 Advanced engineering fundamental knowledge, methods and tools	**4**
Personal and professional skills attributes	**2.1 Analytical reasoning and problem solving**	**4**
	2.2 Experimentation, investigation and knowledge discovery	**4**
	2.3 System thinking	**3**
	2.4 Ethics, though and learning	**4**
	2.5 Ethics, equity and other responsibilities	**4**
Interpersonal skills: Teamwork and communication	**3.1 Teamwork**	**4**
	3.2 Communications	**4**
	3.3 Communications in foreign language	**3**
Conceiving, Designing, implementing, operating, innovating and entrepreneurship in the context of Corporate Social Responsibility	**4.1 External, societal and environmental context**	**3**
	4.2 Enterprise and business context	**3**
	4.3 Conceiving, systems engineering and management	**3**
	4.4 Designing	**4**
	4.5 Implementing	**3**
	4.6 Operating	**3**
	4.7 Leading engineering endeavours	**4**
	4.8 Engineering entrepreneurship	**3**

More specifically, the **key strengths** of the MAGIS-MASI program are as follows:

- It is held in the historical heart of Paris and in research laboratories in Paris areas (CMAT, FAST, LMPS, PIMM, SIMM, etc.);
- It is a joint program between several Parisian engineering schools: Arts et Métiers Institute of Technology, ENS-Paris-Saclay, and CentraleSupélec;
- It involves several industrial partners which give conferences and offer research internships within their own research and development departments: AIRBUS, Air Liquide, CEA, CNES, EDF, ELANOVA, ONERA, RENAULT, SAFRAN, SNCF, etc.;
- Each year, about half of the promotion is made up of foreign students coming from partner universities or engineering schools in order to obtain a double Master's degree: Bauman Moscow State Technical University, ENSAM Casa, ENSAM Meknes, Iran University of Science and Technology, KIT Karlsruhe, Politechnico di Bari, Universidad del País Vasco, Universidad de Valencia, University of Guilan, University of Teheran, etc.;
- Students interact with internationally recognized academic staffs and are in regular contact with industry due to the large volume of research works performed by laboratories for industry.

Program structure

Learning outcomes are reached through a well-balanced training program that combines theoretical and practical learning sequences.

MAGIS-MASI is a second-year Master's program that spreads over two semesters (Figure 1):

- **First semester (S3)**: From September to February
  This semester is composed of 5 general scientific modules, 4 specialized modules, a foreign language module (English for French and francophone students, French for foreign and non-francophone students), and a management module (recommended for ENSAM engineering students only), all dedicated to this program for a total of 30 ECTS.
  Second semester (S4): From March to August
  The second semester is dedicated to the research project followed by the Master thesis lasting (at least) 20 weeks for a total of 30 ECTS.
  The internship will be made in a research structure (i.e. university laboratory or company department) in France or abroad.

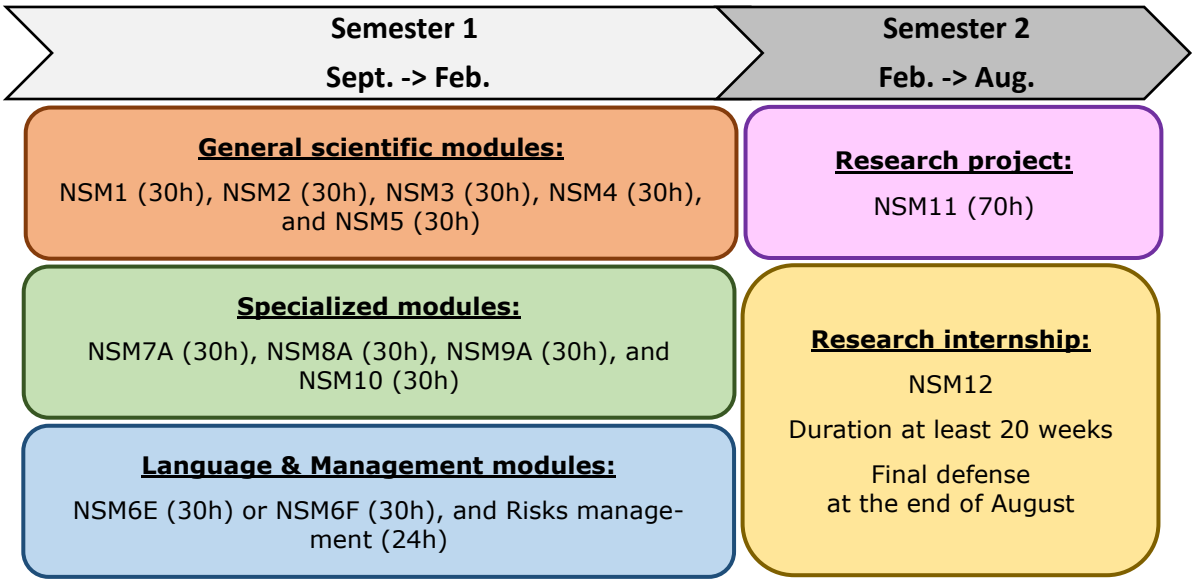

Figure 1: Structure of the MAGIS-MASI program

Code	Title	Semester	ECTS	Hours	Compulsory/ Optional	Teaching modality
NSM1	Materials science	S3	3	30	Compulsory	Lectures/tutorials
NSM2	Materials and structure computation by finite element method	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM3	Artificial intelligence for mechanics of materials	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM4	Algorithmic modelling of multi-physical processes	S3	3	30	Compulsory	Lectures/project
NSM5	Solid mechanics of heterogeneous and architecture materials	S3	3	30	Compulsory	Lectures/tutorials/project
NSM6E	Scientific communication in foreign language	S3	3	30	Compulsory for French and francophone students	Lectures/project
NSM6F	Scientific communication in foreign language	S3	3	30	Compulsory for foreign and non-francophone students	Lectures/project
–	Risks management	S3	–	24	Recommended for engineering ENSAM students	Lectures/project
NSM7A	Multi-physical approach of cutting, materials and material integrity	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM8A	Advanced machining and its application	S3	3	3	Compulsory	Lectures/tutorials/practical works
NSM9A	Material and surface behavior for materials processes and machining	S3	3	30	Compulsory	Lectures
NSM10	Impact of manufacturing processes on mechanical properties and durability	S3	3	30	Compulsory	Lectures/tutorials/project
NSM11	Research project	S4	6	70	Compulsory	Bibliographic study
NSM12	Master Thesis	S4	24	N/A	Compulsory	Research internship

Table 1: Detail of the modules of the MAGIS-MASI track over the two semesters.

Study and assessment rules

Each module can be evaluated by means of tutorials, practical works, projects, reports, poster or oral presentations, and/or exams, and the assessment rules are explained at the beginning of the programme.
Each module is evaluated between 0 and 20.
For all modules, the research project and the master thesis, to validate the ECTS, the final mark should be ≥ 10. There is no compensation between modules.
Resit exams are organized at the beginning of the second semester (at the end of March).

Graduation requirements

To be graduated, students need to comply with the following rules:

- Validate 30 ECTS during the first semester, with a final average ≥ 10 and no mark < 7.
- Validate 30 ECTS during the second semester, with a final average ≥ 10 and no mark < 7.

At the end of the MAGIS-MASI program, the final average is calculated from the average of two semesters, and different honours are awarded (highest honours, high honours, honours) only to students who have no mark < 10.

Careers of graduates and access to further studies

Depending on their results and professional expectations, graduate students can continue their professional careers as a:

- PhD student in industry (CIFRE) or in academia to further investigate and work on up-to-date scientific challenges and thus, become a recognized expert. This is a preliminary step to reach a position of researcher or professor in France or abroad.
- Positions in large companies or start-ups (researcher in R&D laboratory, mechanical design engineer, production workshop manager, project manager, consultant, head of R&D department, etc.) in many industrial fields (aeronautics and space, automotive, building and civil engineering, energy, electricity, nuclear, health, manufacturing, etc.).

Major	Mechanical Engineering		
Master's program	MECHANICS OF MATERIALS FOR ENGINEERING AND INTEGRITY OF STRUCTURES		
Master's Code	MAGIS-MPAM		
Qualification awarded	**Master's degree in Mechanical Engineering**		
Program director	**Prof. Xavier COLIN** (xavier.colin@ensam.eu)		
Mode of study	*Level of qualification*	*Field of study*	*Language of study*
Full Time	**Master Code ISCED 7**	**Engineering Code ISCED-F-07**	**English**
ECTS	*Campus*	*Length of programme*	*Specific arrangements for recognition of prior learning*
60	**Paris**	**1 year (from September to August)**	**Yes (VAE or VAP)**
Keywords	**Materials science – Engineering and solid mechanics – Innovative manufacturing processes – Metal, polymers and composites – Heterogeneous and architecture materials - Numerical methods – Artificial intelligence – Advanced experimental methods – Casting and forge – Additive manufacturing – Multiphysical analysis and modelling – Fatigue and durability**		

Admission requirements

Type	Level	Way
English proficiency	**Level B2**	**Certificate**
Previous degree	**First-year Master's degree (M1) at least, or equivalent, in Engineering**	**Certificate of achievement**

Applicants interested in the MAGIS program must follow the online procedure and adhere to the schedule.

https://artsetmetiers.fr/en/formation/master-admissions

Overall objectives

MAGIS is a second-year Master's program aimed at providing students with a deeper understanding of the fundamentals of materials science and engineering and solid mechanics, as well as a better knowledge of the relationships between the manufacturing processes, the material, its microstructure and its mechanical properties. To illustrate these concepts, the program draws on recent developments in this field, carefully selected from advanced industrial applications and innovative manufacturing technologies. The emphasis is on generic methods, based on fundamental principles and mechanisms, rather than on the specific characteristics of materials.

This general approach in solid mechanics applies to a wide variety of materials (ceramics/glasses, metals, polymers, composites) and gives a complete understanding of the mechanical design and sizing of industrial systems (transport vehicles, nuclear power-plants, etc.) under various and complex external loadings. Students are learned to scientific methodology, ranging from advanced experimental methods to modeling and simulation of the mechanical behavior of structures, through the analysis of the mechanisms involved throughout the material life cycle, including their couplings.

The MAGIS-MPAM track deals more particularly with innovative processing techniques of metals, such as additive manufacturing, and numerical methods for metal processing.

Program learning goals

The table below details the skills to be acquired and the expected proficiency levels in accordance with the following targets:

1) To lead an innovative approach in a disciplinary field that takes into account the complexity of the situation by using information that may be incomplete or seems to be contradictory;
2) To lead a research project (design, fulfilment and management, dissemination) that can mobilize multidisciplinary skills in a collaborative framework and accept responsibilities;
3) To adapt to different socio-professional and intercultural, but also national and international contexts;
4) To update his knowledge in a specialized scientific field by performing a thorough literature review (state-of-the-art);
5) To communicate clearly and concisely (by talk, poster, written report, etc.) in English in front of an audience of specialists and non-specialists.

Sets of expected abilities	***Expected abilities***	***Expected proficiency level***
		R&D
Disciplinary knowledge and reasoning	**1.1 Knowledge of underlying mathematics and science**	**4**
	1.2 Core fundamental knowledge of engineering	**4**
	1.3 Advanced engineering fundamental knowledge, methods and tools	**4**
Personal and professional skills attributes	**2.1 Analytical reasoning and problem solving**	**4**
	2.2 Experimentation, investigation and knowledge discovery	**4**
	2.3 System thinking	**3**
	2.4 Ethics, though and learning	**4**
	2.5 Ethics, equity and other responsibilities	**4**
Interpersonal skills: Teamwork and communication	**3.1 Teamwork**	**4**
	3.2 Communications	**4**
	3.3 Communications in foreign language	**3**
Conceiving, Designing, implementing, operating, innovating and entrepreneurship in the context of Corporate Social Responsibility	**4.1 External, societal and environmental context**	**3**
	4.2 Enterprise and business context	**3**
	4.3 Conceiving, systems engineering and management	**3**
	4.4 Designing	**4**
	4.5 Implementing	**3**
	4.6 Operating	**3**
	4.7 Leading engineering endeavours	**4**
	4.8 Engineering entrepreneurship	**3**

More specifically, the **key strengths** of the MAGIS-MPAM program are as follows:

- It is held in the historical heart of Paris and in research laboratories in Paris areas (CMAT, FAST, LMPS, PIMM, SIMM, etc.);
- It is a joint program between several Parisian engineering schools: Arts et Métiers Institute of Technology, ENS-Paris-Saclay, and CentraleSupélec;
- It involves several industrial partners which give conferences and offer research internships within their own research and development departments: AIRBUS, Air Liquide, CEA, CNES, EDF, ELANOVA, ONERA, RENAULT, SAFRAN, SNCF, etc.;
- Each year, about half of the promotion is made up of foreign students coming from partner universities or engineering schools in order to obtain a double Master's degree: Bauman Moscow State Technical University, ENSAM Casa, ENSAM Meknes, Iran University of Science and Technology, KIT Karlsruhe, Politechnico di Bari, Universidad del País Vasco, Universidad de Valencia, University of Guilan, University of Teheran, etc.;
- Students interact with internationally recognized academic staffs and are in regular contact with industry due to the large volume of research works performed by laboratories for industry.

Program structure

Learning outcomes are reached through a well-balanced training program that combines theoretical and practical learning sequences.

MAGIS-MPAM is a second-year Master's program that spreads over two semesters (Figure 1):

- **First semester (S3)**: From September to February
  This semester is composed of 5 general scientific modules, 4 specialized modules, a foreign language module (English for French and francophone students, French for foreign and non-francophone students), and a management module (recommended for ENSAM engineering students only), all dedicated to this program for a total of 30 ECTS.
  Second semester (S4): From February to August
  The second semester is dedicated to the research project followed by the Master thesis lasting (at least) 20 weeks for a total of 30 ECTS.
  The internship will be made in a research structure (i.e. university laboratory or company department) in France or abroad.

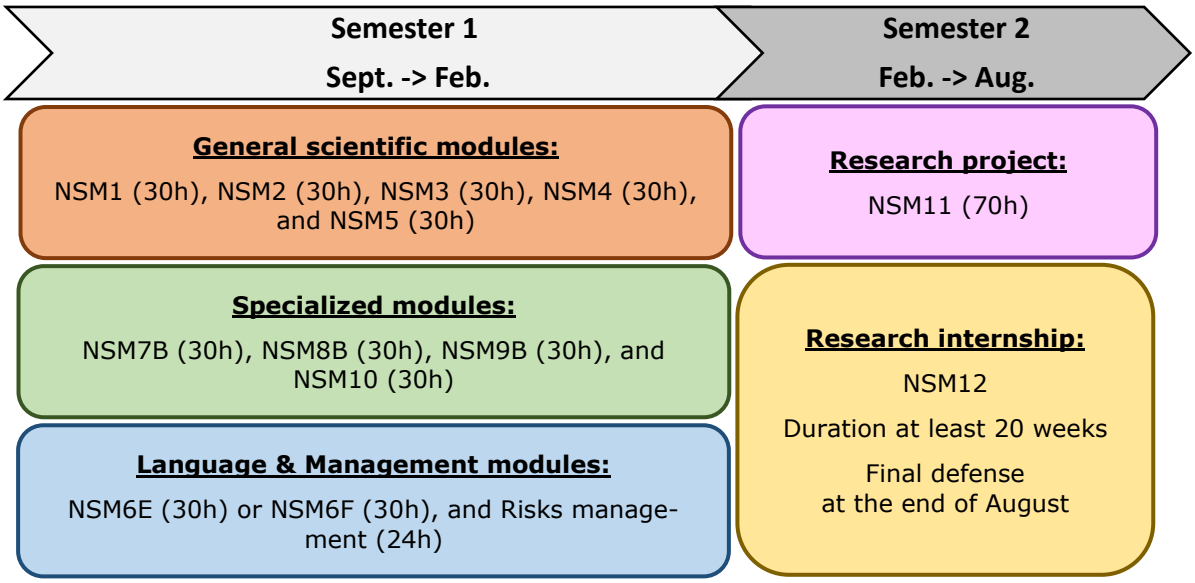

Figure 1: Structure of the MAGIS-MPAM program

Code	Title	Semester	ECTS	Hours	Compulsory/ Optional	Teaching modality
NSM1	Materials science	S3	3	30	Compulsory	Lectures/tutorials
NSM2	Materials and structure computation by finite element method	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM3	Artificial intelligence for mechanics of materials	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM4	Algorithmic modelling of multi-physical processes	S3	3	30	Compulsory	Lectures/project
NSM5	Solid mechanics of heterogeneous and architecture materials	S3	3	30	Compulsory	Lectures/tutorials/project
NSM6E	Scientific communication in foreign language	S3	3	30	Compulsory for French and francophone students	Lectures/project
NSM6F	Scientific communication in foreign language	S3	3	30	Compulsory for foreign and non-francophone students	Lectures/project
–	Risks management	S3	–	24	Recommended for engineering ENSAM students	Lectures/project
NSM7B	Manufacturing processes: Casting and forge	S3	3	30	Compulsory	Lectures/tutorials/practical works
NSM8B	Numerical simulation for metal processing	S3	3	3	Compulsory	Lectures/tutorials/practical works
NSM9B	Additive manufacturing of metals	S3	3	30	Compulsory	Lectures/tutorials
NSM10	Impact of manufacturing processes on mechanical properties and durability	S3	3	30	Compulsory	Lectures/tutorials/project
NSM11	Research project	S4	6	70	Compulsory	Bibliographic study
NSM12	Master Thesis	S4	24	N/A	Compulsory	Research internship

Table 1: Detail of the modules of the MAGIS-MPAM track over the two semesters.

Study and assessment rules

Each module can be evaluated by means of tutorials, practical works, projects, reports, poster or oral presentations, and/or exams, and the assessment rules are explained at the beginning of the programme.
Each module is evaluated between 0 and 20.
For all modules, the research project and the master thesis, to validate the ECTS, the final mark should be ≥ 10. There is no compensation between modules.
Resit exams are organized at the beginning of the second semester (at the end of March).

Graduation requirements

To be graduated, students need to comply with the following rules:

- Validate 30 ECTS during the first semester, with a final average ≥ 10 and no mark < 7.
- Validate 30 ECTS during the second semester, with a final average ≥ 10 and no mark < 7.

At the end of the MAGIS-MPAM program, the final average is calculated from the average of two semesters, and different honours are awarded (highest honours, high honours, honours) only to students who have no mark < 10.

Careers of graduates and access to further studies

Depending on their results and professional expectations, graduate students can continue their professional careers as a:

- PhD student in industry (CIFRE) or in academia to further investigate and work on up-to-date scientific challenges and thus, become a recognized expert. This is a preliminary step to reach a position of researcher or professor in France or abroad.
- Positions in large companies or start-ups (researcher in R&D laboratory, mechanical design engineer, production workshop manager, project manager, consultant, head of R&D department, etc.) in many industrial fields (aeronautics and space, automotive, building and civil engineering, energy, electricity, nuclear, health, manufacturing, etc.).