COURSE OUTLINE

of the class 2026-2028

Transilvania University of Braşov

Master's degree study programme	**MATERIALS SCIENCE, ENGINEERING, AND MANAGEMENT (IN ENGLISH)**
Fundamental field	**Engineering Sciences**
Master's degree study field	**Materials Engineering**
Faculty	**Faculty of Materials Science and Engineering**
Duration of studies	**2 years**
Form of education:	**Full-time (IF)**
Type of master's study programme:	**research**

1. EDUCATIONAL OBJECTIVES AND COMPETENCES

The general objective of the study programme is to provide students with advanced knowledge, research skills, and managerial competencies required to design, synthesize, characterize, and implement innovative materials and technologies. The programme fosters interdisciplinary expertise by integrating fundamental and applied aspects of materials science with engineering problem-solving and modern management approaches, preparing graduates to address complex challenges in industrial applications, research and development, and sustainable technological innovation.

Occupations Accessible in the Labor Market:
ISCO-08/ESCO/COR: 2146 - Mining engineers, metallurgists and related professionals (COR: Ingineri mineri, petroliști, metalurgiști și asimilați)

- COR 214651 – Research Engineer in Materials Science (inginer de cercetare în știința materialelor)
- COR 214652 – Research Assistant in Materials Science (asistent de cercetare în știința materialelor)
- COR 214639 – Research Engineer in Steelmaking Process Engineering (inginer de cercetare în ingineria proceselor siderurgice)

The objectives and the profile of competencies developed in accordance with the needs identified on the labor market, and with the national qualifications' framework are summarized below and detailed in the syllabi of the curriculum.
The Master's degree program MATERIALS SCIENCE, ENGINEERING, AND MANAGEMENT provides training at EQF level 7 (Bologna cycle II - master's degree studies) for students who have graduated from the bachelor's degree programs in the fields of: Mechanics, Materials Engineering, Industrial Engineering, Engineering and Management. The Master's degree program assumes the mission of training specialists in the field of Materials Engineering, capable of using valuable scientific and technical knowledge. In particular, the program has as its mission the specialization of graduates of higher technical education in the design of technologies for obtaining products in the field of advanced materials engineering, based on metallic, ceramic, composite, and polymer materials, used in leading industries. The program also offers a solid structure of theoretical and practical knowledge of engineering and management, which will allow the future graduates to successfully use the knowledge acquired in the business environment. Through the objectives pursued, the mission of the study program falls within the mission of the Faculty and that of Transilvania University of Brașov.

Specific objectives:

- In-depth knowledge of the specific characteristics of advanced materials such as metallic, ceramic, composite, etc.

- Deepening the advanced processing technologies of multifunctional advanced materials.
- Knowledge and application of software programs specific to the field of advanced materials.
- Understanding analysis techniques regarding the characterization of materials.
- Modeling and simulation of processes.
- Development of quality and environmental protection concepts.
- Development of managerial skills in the field of materials.

Professional competences and learning outcomes

Cp.1. Use of modern concepts and theories in the field of advanced materials (ESCO - evaluates the suitability of metal types for specific applications; manipulates metals; works in metal production teams)

Knowledge

L.O. 1.1. The graduate defines modern concepts and theories in the field of advanced materials.

L.O. 1.2. The graduate describes how materials engineering products and processes have a positive impact on global and social issues, using modern concepts and theories in the field of advanced materials.

Skills

L.O. 1.3. The graduate analyses data obtained from the use of the structure-property relationship for the characteristics of different types of materials and especially metallic, polymer, ceramic and composite materials.

L.O. 1.4. The graduate can identify opportunities and design strategies in solving needs in the field of materials engineering.

Responsibility and autonomy

L.O. 1.5. The graduate has autonomy in learning.

L.O. 1.6. The graduate autonomously integrates concepts and theories in materials engineering into new contexts in the workplace.

Cp.2. Identifying and defining a research topic in the field of advanced materials and developing a plan to achieve the proposed objectives (ESCO - approaches problems critically; develops materials testing procedures; presents reports on test results)

Knowledge

L.O. 2.1. The graduate can identify and define a topic of actuality or of maximum necessity in the field of advanced materials through the criterial materials selection.

L.O. 2.2. The graduate can identify, define and develop a specific plan for processing advanced materials according to technological parameters in achieving the proposed objectives.

Skills

L.O. 2.3. The graduate can develop a plan for selecting appropriate tools for advanced materials processing, using them safely to achieve the proposed objectives.

L.O. 2.4. The graduate can use modern tools and techniques to modify, characterize and measure the properties of materials and to design processes according to accepted standards.

Responsibility and autonomy

L.O. 2.5. The student/graduate selects and uses bibliographic sources specific to the field.

L.O. 2.6. The student/graduate demonstrates autonomy in learning on issues specific to the field.

Cp.3. Application of modern analytical techniques adapted to the field of advanced materials and related fields (ESCO - performs laboratory tests; prepares samples for analysis; performs sample analysis; uses chemical analysis equipment; applies laboratory safety procedures; performs metallurgical structural analysis)

Knowledge

L.O. 3.1. The graduate has a deep understanding of various modern analytical techniques, adapted to the field of advanced materials and related fields.

L.O. 3.2. The graduate uses various modelling, simulation and optimization software techniques and applications, adapted to the field of advanced materials and related fields.

L.O. 3.3. The graduate can collect, interpret and analyze data that is specific to the application of modern analytical techniques to extract relevant conclusions in the field of advanced materials and related fields.

Skills

L.O. 3.4. The graduate can design and analyze experiments appropriate to modern analytical techniques in the field of advanced materials and related fields, incorporating statistical procedures.

L.O. 3.5. The graduate can use modelling, simulation and optimization software programs to develop and evaluate new materials.

Responsibility and autonomy

L.O. 3.6. The graduate ensures the rigor of the analysis through judicious selection of data and methods.

L.O. 3.7. The graduate assumes responsibility for the validity of the conclusions resulting from the data analysis.

Cp.4. Use of basic concepts in the field of research management in materials engineering (ESCO - manages engineering projects; finds solutions to problems; applies numerical calculation skills; provides project management; identifies process improvements; prepares scientific reports; makes independent operational decisions)

Knowledge

L.O. 4.1. The graduate knows and understands the basic concepts in the field of research management in materials engineering, being able to approach complex and interdisciplinary projects involving materials.

Skills

L.O. 4.2. The graduate applies the basic concepts of research management in materials engineering based on logical and thorough reasoning, with the purpose of interpreting various types of situations, processes, and projects specific to engineering and management. The graduate designs and carries out research activities using validated scientific methods.

L.O. 4.3. The graduate can perform calculations, demonstrations, and applications to solve tasks specific to materials engineering, based on knowledge of fundamental sciences.

L.O. 4.4. The graduate can prepare and interpret technical and managerial documentation specific to research in the field of materials engineering.

Responsibility and autonomy

L.O. 4.5. Manages individual or group research activities.

L.O. 4.6. The graduate applies the values of ethics and professional conduct as a materials engineer.

L.O. 4.7. The graduate correctly evaluates the workload, manages available resources, and respects the deadlines for completing professional tasks.

Cp.5. Applying the principles of scientific research specific to the field and carrying out an oral/written communication, through which the results are presented, in a clear and convincing manner. (ESCO - conducts scientific research; tests materials; develops advanced materials).

Knowledge

L.O. 5.1. The graduate knows how to apply the principles of scientific research specific to the field and to communicate clearly and concisely, both in writing and orally, regarding the results obtained by applying the principles of scientific research specific to the field of advanced materials and related fields.

Skills

L.O. 5.2. The graduate can apply the principles of scientific research specific to the field by acquiring the ability to perceive, understand and promote quality and creativity in research and communication of the results obtained.

L.O. 5.3. The graduate can develop skills as a researcher and good communicator in the field of materials engineering by applying the principles of scientific research by extracting relevant conclusions from the research carried out.

L.O. 5.4. The graduate knows how to correctly communicate the results of analyses and calculations carried out in scientific research, thus explaining the correctness of the proposed solutions.

Responsibility and autonomy

L.O. 5.5. The graduate assumes the intellectual paternity of his/her own research and respects the deontological norms.

L.O. 5.6. The graduate demonstrates autonomy in the dissemination of knowledge by initiating and managing the publication process.

Cp.6. Advanced materials management and correlation of their acquisition with alternative resources available in the context of sustainable development. (ESCO - develops problem-solving strategies; assesses environmental impact)

Knowledge

L.O. 6.1. The graduate can explain the diversity and continuous evolution of materials engineering in finding new materials as alternative resources available in the context of sustainable development.

L.O. 6.2. The graduate can identify alternative solutions to materials engineering by analyzing the possibilities offered by unconventional technologies in processing new materials in the context of sustainable development.

Skills

L.O. 6.3. The graduate can choose correct solutions in processing materials using alternative resources available in the context of sustainable development.

Responsibility and autonomy

L.O. 6.4. The graduate correctly assesses potential risk factors and how to manage them while respecting restrictions on environmental impact.

Transversal competences and learning outcomes

Ct.1. Performing complex professional tasks, respecting the norms of professional ethics and moral conduct, following a personal work plan established based on individual study (ESCO - applies scientific, technological and engineering knowledge; develops strategies for solving problems.)

L.O. 1.1. The graduate can perform complex professional tasks while observing the rules of professional ethics and moral conduct, following a self-established work plan based on individual study.

L.O. 1.2. The graduate can identify continuous training opportunities and using them effectively for personal development in carrying out complex professional tasks, following a self-established work plan based on individual study.

L.O. 1.3. The graduate is capable of recognizing, understanding, and promoting quality and creativity in performing complex professional tasks.

L.O. 1.4. The graduate knows the occupational health and safety regulations, thus ensuring safe working conditions for themselves and for the team they are part of.

Ct.2. Planning, monitoring and assuming the professional tasks of a subordinate professional group(s) (ESCO - has teamwork capacity; demonstrates organizational skills)

L.O. 2.1. The graduate can plan and monitor the execution of complex professional tasks carried out by a group or subordinate professional teams.

L.O. 2.2. The graduate can take responsibility for the consequences of decisions made while coordinating complex professional activities carried out by a group or subordinate professional teams.

Ct.3. Permanent information and documentation in his/her field of activity and related fields, in correlation with the needs of the labor market (ESCO - demonstrates a desire to learn; manages personal development.)

L.O. 3.1. The graduate can identify continuous training opportunities and use them effectively for personal development in their field or related activities and domains, in correlation with labor market needs.

L.O. 3.2. The graduate can develop original models to accurately describe real processes specific to materials engineering, based on thorough individual study.

L.O. 3.3. The graduate is capable of objectively and effectively self-assessing their professional activity, thereby gaining an overall understanding of their own knowledge, with a strong emphasis on continuous information gathering and documentation in their field of activity.

2. STRUCTURE PER WEEKS OF THE ACADEMIC YEAR

Number of semesters: 4 semesters.
Number of credits per semester: 30 credits
Number of hours of teaching activities /week: 26
Number of weeks: 14

	Teaching activities		Exam sessions			Holidays		
	Sem. I	Sem. II	Winter	Summer	Retakes	Winter	Spring	Summer
Year I	14	14	3	4	2	2	1	11
Year II	14	14	3	3	2	2	1	8

3. PROVISION OF EDUCATION FLEXIBILITY. CONDITIONINGS

The flexibilization of the study programme is ensured by optional disciplines. The optional disciplines are proposed for the semesters 1-3, through packages of specialized disciplines.

4. CONDITIONS OF ENROLLMENT IN THE FOLLOWING STUDY YEAR. CONDITIONS FOR PASSING A STUDY YEAR

Enrollment in the following year is conditional on meeting the conditions for passing contained in the *Regulations on students' professional activity*.

5. CONDITIONS FOR ATTENDING THE FACULTATIVE DISCIPLINES

This Course Outline does not include facultative disciplines.

6. REQUIREMENTS FOR OBTAINING THE MASTER'S DEGREE DIPLOMA

The conditions for taking the dissertation exam are presented in the "*Methodology for the academic studies final examination"* document, approved by the Senate of the University. According to this methodology, in order to enter the dissertation exam, all disciplines laid down in the course outline must have been passed.

DISSERTATION EXAM

1 Period of drafting the dissertation: **4th semester;**
2 Period of completing the dissertation: **the last 3 weeks of the terminal year;**
3. Period of defending the dissertation exam: **20-30th of July 2028**
4. Number of credits for defending the dissertation: **10 credits**.

Transilvania University of Brașov — Ministry of Education and Research
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YEAR I

No.	Compulsory disciplines	Type*	Semester I						Semester II					
			C	S	L	P	Ver.	Cred.	C	S	L	P	Ver.	Cred.
1	**Introduction to materials science**	**DF**	2	0	0	2	E	5						
2	**Criteria for materials selection**	**DF**	2	0	0	2	E	6						
3	**Process modelling, simulation, and optimization**	**DS**	2	2	0	0	E	6						
4	**Ethics and academic integrity**	**DC**	2	0	0	1	V	3						
5	**Fundamentals of solid-state phase transformations**	**DF**							2	0	1	0	E	4
6	**Advanced characterization methods**	**DS**							2	0	2	0	E	6
7	**Nanomaterials**	**DS**							2	0	2	1	E	5
8	**Expert software: CAD, CAM, CAE**	**DS**							2	0	1	1	E	5
9	**Research practice I**	**PC**	0	0	0	6	V	5						
10	**Research practice II**	**PC**							0	0	0	6	V	5
Total hours compulsory disciplines			8	2	0	11			8	0	6	8		
			21					25	22					25

No.	Optional disciplines	Type	Semester I						Semester II					
			C	S	L	P	Ver.	Cred.	C	S	L	P	Ver.	Cred.
Choose one discipline from each package:														
Optional package 1														
11	Sustainable materials	DC	2	0	1	2	E	5						
	Materials recycling and environmental management	DC												
Optional package 2														
12	Logistics and material management	DC							2	1	0	1	E	5
	Integrated waste management	DC												
Total hours optional disciplines per week			5				5		4				5	
Total			26					30	26					30

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YEAR II

No.	Compulsory disciplines	Type*	Semester III						Semester IV					
			C	S	L	P	Ver.	Cred.	C	S	L	P	Ver.	Cred.
13	**Biomaterials**	**DS**	1	0	2	0	V	4						
14	**Functional materials**	**DS**	2	0	2	1	E	5						
15	**Additive manufacturing**	**DS**	2	0	1	1	E	4						
16	**Surface engineering**	**DS**	2	0	2	1	E	6						
17	**Research practice III**	**PC**	0	0	0	6	V	5						
18	**Research project management**	**DC**							2	0	0	2	V	4
19	**Total quality management**	**DC**							2	2	0	0	V	5
20	**Research practice IV**	**PC**							0	0	0	6	E	5
21	**Practice for dissertation preparation**	**PLD**							0	0	0	6	V	6
22	**Drafting the dissertation**	**PLD**							0	0	0	6	V	10
Total hours compulsory disciplines			**7**	**0**	**7**	**9**		**24**	**4**	**2**	**0**	**20**		**30**
			23						**26**					

No.	Optional disciplines	Type	Semester III						Semester IV					
			C	S	L	P	Ver.	Cred.	C	S	L	P	Ver.	Cred.
Choose one discipline from each package:														
Optional package 1														
23	Materials for energy	DS	2	0	2	1	E	6						
	Materials processing	DS												
Total hours optional disciplines per week			2	0	2	1		6						
			5											
Total			28					30	26					30

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GENERAL BALANCE SHEET I

No.	Discipline	No. of hours		Total		No. of credits	
		Year I	Year II	hours	%	Year I	Year II
1	Compulsory	602	686	1288	86,79	50	54
2	Optional	126	70	196	13,21	10	6
TOTAL		1484				60	60

GENERAL BALANCE SHEET II

No	Discipline	No. of hours		Total		No. of credits	
		Year I	Year II	hours	%	Year I	Year II
1	Fully / partially assisted disciplines	560	420	980	66,04	50	34
2	Specialized practice	168	168	336	22,64	10	10
3	Practice for drafting the dissertation	0	168	168	11,32	0	16
TOTAL		728	756	1484	100	60	60

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