



Deliverable 1

Joint programme and integrated teaching/training activities

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Project Co-ordinator:	University of Limerick Prof. Syed A. M. Tofail +353 (0) 86 7804173 tofail.syed@ul.ie
Core Partners:	WUST (PL), FHM (DE)
Associate Partners:	CUB (SK), UNILIM (FR), IITM (IN), BUET (BD)



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Executive Summary

The Master in Emerging Materials Science and Engineering (MEMSE) is an Erasmus Mundus Design Measure project funded under the ERASMUS-EDU-2024-EMJM-DESIGN call (Grant Agreement No. 101180422). The purpose of this Design Measure is to develop a robust framework for the creation of a new, high-level, transnational Joint Master Degree in Emerging Materials Science and Engineering.

This Deliverable provides a full Joint Master Programme with integrated teaching activities and three mobilities of students spending at least two semesters at two of the Core Partners in addition to provisions for Spring, Summer Autumn, Winter school with assessments for learner success and evaluation built in with selection of guest speakers, and clear joint delivery by the 3 Core Partners culminating in a joint award. It includes learning outcomes, a detailed list of modules and the learning experiences students will undertake. This will be presented in English and include info graphs setting out the structure. It will be published on the website and available to download in a PDF brochure.

The ultimate ambition of MEMSE is to establish a sustainable, internationally competitive Joint Master programme capable of producing future-ready graduates equipped to lead innovation in emerging materials science and engineering across Europe and globally. This Deliverable facilitated that.

1. Introduction

The Master in Emerging Materials Science and Engineering (MEMSE) is an Erasmus Mundus Design Measure project funded under the ERASMUS-EDU-2024-EMJM-DESIGN call (Grant Agreement No. 101180422).

The Programme is a 'Joint Programme' with an integrated curriculum coordinated by the University of Limerick, Ireland (the Coordinator) and offered jointly by the Core Partners (Wroclaw University of Science and Technology, Poland and FH Münster, Germany) leading to multiple degrees awarded by the Core Partners attesting to the successful completion of the Programme. Deliverable 1 provides a full Joint Master Programme with integrated teaching activities and three mobilities of students spending at least two semesters at two of the Core Partners in addition to integrated provisions for Spring, Summer Autumn, Winter school with assessments for learner success and evaluation built in with selection of guest speakers, and clear joint delivery by the 3 Core Partners culminating in a joint award. It includes learning outcomes, a detailed list of modules and the learning experiences students will undertake. This will be presented in English and include info graphs setting out the structure. It will be published on the website and available to download in a PDF brochure.

2. MEMSE: Full Joint Master Programme for Joint Delivery

2.1 The Objectives and Structure of Integrated Curriculum

- (a) MEMSE is a comprehensive 2-year (4 semesters, 120 ECTS) full-time Master programme with integrated teaching and compulsory mobility. It combines the specific expertise and programme specializations offered by the three **Core Partners** and four **Associate Partners** (Comenius University of Bratislava, Slovakia, University of Limoges, France, Bangladesh University of Engineering and Technology, Bangladesh and Indian Institute of Technology, Madras, India) of the MEMSE Consortium.
- (b) MEMSE will provide advanced education and interdisciplinary training in the field of sustainable materials, advanced manufacturing technologies, and emerging material systems. It integrates expertise from multiple institutions and combines academic coursework, international mobility, research training, and industry engagement.
- (c) MEMSE addresses global technological and environmental challenges through innovation in sustainable materials and technologies through an academic structure that is built on the following key principles:

- International mobility and collaborative education
- Integration of sustainability and emerging materials science
- Strong connection between academia and industry
- Interdisciplinary training across materials science, engineering, and sustainable technologies
- Joint academic oversight across partner institutions.
- Students enrolled in the Programme will benefit from access to the research infrastructure, academic expertise, and industrial networks of all Partners.

Academic Year 1, Semester 1

Compulsory

PH6011	Experimental Design and Research Methodology	6
PH5XXX	Winter School	3
CO6001	Professional Development	3

Electives

PH5041	Condensed Matter Physics	6
PH5091	Physics of Solids	6
PH5093	Physics of Advanced Metrology	6
PH5094	Nanoscience and Nanotechnology 1	6
PH5098	Semiconductor Processing 1	6
PH6071	Advanced Analysis of Materials 1	6
PH6081	Earth and Atmospheric Science	6

Academic Year 1, Semester 2

Nanostructures in Industrial and Numerical Applications	6
Summer School	3
Economics and Management (Placement/Internship/Skill Development)	3
<i>Electives (Pick 3)</i>	
Structure and Crystallography of Solids	6
Synthesis and Fabrication of Nano-engineering Systems	6
Fabrication of Smart Polymers	6
Engineering of Nano-machines	6
Biomaterials-Biomedical Devices	6
Biophotonics	6

Academic Year 2, Semester 1

ITB.2.0034.0.P Dielectrics and Ceramics	6
XXXX Summer School	3
ITB.2.0024.0.P Business Simulation (Placement/Internship/Skill Development)	3
<i>Electives (Pick 3)</i>	
CIW.2.0065.0.P Applied Process Development	6
ITB.2.0066.0.P Life-Cycle Assessment	6
MB.2.0063.0.P Innovative Materials	6
PHY.2.0127.0.P Battery Production	6
PHY.2.0121.0.M Quantum Sensors	6
ITB.2.0093.0.P Photovoltaic System	6

Year 2 Semester 2

MSc Research Thesis

2.2 Student Mobility

The Programme curriculum includes three compulsory mobilities. A mobility is defined as studying a full semester and obtaining at least 30 ECTS at a University that is different than the University where the student studied in the previous semester. The mobility scheme is specified in MEMSE Programme, Grading and Graduation Specifications included as specified in the MEMSE Handbook and Regulations.

Students will follow the following compulsory mobility paths:

Mobility 1. Foundations and Sustainability Frameworks @ University of Limerick (UL), Ireland, Semester 1, Academic Year 1: ***Mobility*** (\Rightarrow) to Wroclaw University of Science and Technology (WUST), Poland.

Mobility 2. Advanced Materials Processing and Computational Approaches @ Wroclaw University of Science and Technology (WUST), Poland Semester 1, Academic Year 1: ***Mobility*** (\Rightarrow) FH Münster, Germany.

Mobility 3. Specialisation Tracks and Applied Laboratories @ FH Münster, Germany. Semester 1, Academic Year 2 ***Mobility*** (\Rightarrow) Any **Partner** of the Programme for Master Thesis and Colloquium.

During Semester 1 of Year 1 at the University of Limerick, students focus on sustainability, research methods, and foundational knowledge in materials science. Semester 2 of Year 2 at Wroclaw University of Science and Technology builds advanced competence in materials processing, computational modelling, and industrial systems orientation. In Semester 3 of Year 4, hosted by FH Münster, students undertake deep thematic specialisation through applied laboratory work and industry-adjacent modules. Semester 4 of Year 2 is dedicated to the Master's thesis, which may be undertaken at any consortium partner institution, and optionally in an industrial setting, while adhering to the programme's joint supervision framework. This structured and academically differentiated mobility model reflects established practice within Erasmus Mundus Joint Master programmes and ensures that partner excellence areas contribute coherently to the overall learning pathway. An indicative breakdown of 120 ECTS distributed over the 4 semesters of the Programme with 30 ECTS credits per semester is shown in section 5.1.

Each compulsory mobility path has its own curriculum composed of compulsory and elective/optional modules/lectures/courses in general fields of sustainability, materials science, processing and engineering and research methods, data science and management, computational approaches and transferable skills in accordance with the focus of each path coherent with locally available and managed study plan (section 2.1).

Students will declare at the time of application, their mobility path, compulsory modules and a ranked preference of elective modules.

Optional mobility may take place between first and second academic year motivated by specific research interest of students requiring thesis co-supervision, internship, or secondment opportunities. Students may also have the opportunity to participate in industry training through short-term industrial placements, professional training within industrial research laboratories at any Partners supported through letters of intent, internship agreements, or collaborative training frameworks.

2.3 Master Thesis and Integrated Spring/Summer/Winter Schools

To graduate from MEMSE, student must carry out research to complete and submit a Master Thesis. The Master thesis will be supervised under a structured consortium framework designed to ensure academic quality, joint ownership, and interdisciplinary perspectives. The detailed requirements regarding the master thesis will be specified. Semester 2 of AY 2 is be dedicated for research projects leading to Thesis (Section 2.1).

Students must register with one of the Core Partners. All Partners can host Students for a partial or full duration of Semester 2 of AY 2. Core Partners can supervise and/or co-supervise Theses. Associated Partners can co-supervise. They can be primary supervisors or host supervisors provided that the student thesis is offered and registered through one of the Core Partners with co-supervision from one the one of the staff members of the respective Core Partner.

The primary or host supervisor from a Partner is responsible for overseeing the research work, together with a co-supervisor from the Sender institution to reinforce the joint nature of the MEMSE Programme, provide complementary expertise, and ensuring consistent management of Student mobility and MEMSE Learning Outcomes (Section 3). Where appropriate, particularly for practice-oriented or applied research topics, an industry mentor may also be involved in the supervision process to contribute practical insight and ensure relevance to industrial contexts. Industry can accede as Associate Partners or can be involved through bilateral agreements with one of the Partners subject to the authorization of the Governance Board.

Students will provide a ranked selection list for thesis topics and host supervisors in Semester 1 of Academic Year 2. The allocation of thesis topic, supervisors, host institute associated with student mobility path/s will be decided by the Governing Board based on the recommendation made by Joint Programme Management Board (JPMB) which will take into consideration student preferences and ranking as well as specific requirements, advantages and/or limitations of any host **Partners**.

MEMSE integrates Spring, Summer and/or Winter schools into the planned academic activity to bring together students, academic staff, and industry partners for intensive thematic training including but not limited to:

- specialised workshops/symposium
- laboratory training and/or demonstration
- interdisciplinary project work

- industry-focused innovation challenges
- networking events.

These schools will award ECTS credit and can be scheduled between academic semesters at the convenience of the Core Partner who is organizing it. Students who, for a good reason, are unable to participate in these must notify the Coordinator as soon as possible. These students will be given the option to join a school in the following Academic Year, or additional coursework by the end of the respective Academic Year.

2.4 Assessments of Learners Success and Evaluation

- (a) For each course/module/thesis the examination criteria of the host **Partner**, where the course/module/thesis is taken, apply. Examination results are transferred between/with **Core Partners** and fully recognized by all **Partners**.
- (b) All marks/grades obtained by students for courses/module/thesis completed at each Core Partner institution will be expressed in national scales of the Partner Universities. They will be associated with the European Credit Transfer System (ECTS). The calculation of the final grade shall be determined by factoring in the Coordinating Institution's weightage, which takes into consideration any disparities in ECTS credits acquired at the partner institution as compared to those granted by the Coordinating Institution and converted according to the MEMSE Consortium Student Grade Conversion Table.
- (c) **Core Partners** will process respective Grade rechecks and repeat examinations students according to the local Regulations and Academic Calendar for deadlines.

Thesis assessment will be conducted through a two-stage evaluation process. This includes a written evaluation of the submitted thesis by academic examiners, followed by an oral defense (colloquium). During the defense, the student will present their research work and respond to questions from the thesis committee, allowing for a comprehensive assessment of the scientific quality of the thesis, the student's understanding of the research topic, and their ability to communicate and defend their findings effectively.

2.5 Degree Awarding and Degree Certificates

The Consortium is committed to delivering a Joint Master Programme through **multiple degree award pathway** in accordance with the appropriate legislation in each of the partner countries. Upon successful completion of requirements of the Programme, students will receive three individual master degrees, each issued by one of the Core Partners in compliance with the respective institutional procedures through multiple degree award pathway in accordance with the respective national legislation, for example:

Ireland: Universities Act 1997 and Qualifications and Quality Assurance (Education and Training) Act 2012, as amended 2019;

Poland: Law on Science and Higher Education of 20 July 2018 and respective bylaws.

Germany: Länder Higher Education Acts (Landeshochschulgesetze), the Standing Conference of the Ministers of Education and Cultural Affairs (KMK) resolutions on joint programmes and the use of academic titles, and the Musterrechtsverordnung (MRVO) on accreditation, implementing the European Approach for Quality Assurance of Joint Programmes.

Students will also receive a common certificate issued by the Consortium, confirming successful completion of the Erasmus Mundus Master in Emerging Materials Science and Engineering. The joint certificate (the Certificate here to fore) will be signed by the authorised representatives of the three Core Partners (such as the Partner Leader/Coordinator, or Head of Department, programme director, or institutional leadership). The Certificate will serve as formal recognition of the collaborative nature of The Programme and the integrated curriculum completed across the Partners.

Students will also receive degree supplement following the model developed by the European Commission, Council of Europe and UNESCO/CEPES. The purpose of the supplement is to provide sufficient independent data to improve the international ‘transparency’ and the fair academic and professional recognition of qualifications (diplomas, degrees, certificates etc.). It is designed to provide a description of the nature, level, context and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It is free from any value judgements, equivalence statements or suggestions about recognition.

At the end of each semester, Core Partners shall issue transcripts of records for all students hosted at their University. Students on mobility will receive a leave of absence from the non-host Core Partners. Partner Leaders of Core Partners will be responsible for sending the transcripts to the Chair of JPMB for recording in the general student monitoring database of the

Programme and other Core Partners. The Coordinating Institution will issue a transcript for all students at the end of each of the two academic years of the Programme.

3. Learning Outcomes

Core partners needed open channel of communication established both internally between various departments within their respective universities and externally between themselves. The design process follows a structured, evidence-based methodology grounded in industry relevant and collaborative curriculum development. Key elements in the design planning involved industry scan and skills mapping to define measurable learning outcomes. Indicative learning outcomes of MEMSE to address unmet industry needs underpinned by sustainability, environment, and climate change are given below.

3.1 Learning Outcomes Target 1: Sustainability Literacy and Systems Thinking

Graduates will be able to:

1. Demonstrate advanced understanding of sustainability principles in materials science and engineering.
2. Analyse materials innovation within interconnected industrial, environmental, and supply chain systems.
3. Evaluate sustainable production cycles incorporating environmental impact and carbon footprint considerations.
4. Integrate environmental, economic, and technological dimensions into materials design decisions.
5. Apply interdisciplinary knowledge (physics, chemistry, engineering, nanotechnology, AI) in a systems-based framework.

3.2 Learning Outcomes Target 2: Climate Change Science, Adaptation and Mitigation

Graduates will be able to:

1. Explain the role of emerging materials in climate change mitigation and energy transition.
2. Evaluate materials solutions contributing to energy security (e.g., batteries, energy materials, semiconductors).

3. Design materials strategies aligned with low-carbon and net-zero industrial objectives.
4. Assess environmental impacts of materials production and processing.
5. Develop adaptation-oriented materials solutions for sustainable infrastructure and advanced technologies.

3.3 Learning Outcomes Target 3: Sustainable Materials and Technologies

Graduates will be able to:

1. Design and evaluate sustainable structural and functional materials for advanced industrial applications.
2. Apply advanced characterisation and laboratory methods to emerging materials.
3. Integrate additive manufacturing and nanotechnology approaches in sustainable materials development.
4. Develop alternative materials to substitute scarce and critical raw materials.
5. Apply materials informatics and modelling to accelerate sustainable materials innovation.

3.4 Learning Outcomes Target 4: Environmental Compliance & Policy Integration

Graduates will be able to:

1. Interpret regulatory, environmental, and quality management frameworks relevant to advanced materials industries.
2. Integrate sustainability, environmental impact, and health and safety considerations into materials innovation.
3. Align materials development strategies with European sustainability objectives and environmental standards.
4. Apply quality management and documentation practices in industrial contexts.
5. Demonstrate awareness of intellectual property management in industry-linked innovation.

3.5 Learning Outcomes Target 5: Digitalisation for Sustainability

Graduates will be able to:

1. Apply AI and machine learning approaches in materials modelling and design.
2. Use material informatics to enhance sustainable materials discovery.

3. Employ simulation and computational tools for environmentally responsible materials optimisation.
4. Integrate digital technologies in accelerating innovation cycles and shortening time to market.
5. Analyse how digital transformation supports sustainable industrial systems.

3.6 Learning Outcomes Target 6: Circular Economy & Resource Efficiency

Graduates will be able to:

1. Evaluate circular economy strategies in materials production and processing.
2. Design materials systems that enhance recyclability and resource efficiency.
3. Assess lifecycle impacts of materials across supply chains.
4. Develop strategies to reduce material waste and environmental burden.
5. Contribute to sustainable industrial ecosystems through responsible materials innovation.

3.7 Learning Outcomes Target 7: Sustainability Leadership and Responsible Innovation

Graduates will be able to:

1. Lead interdisciplinary teams addressing sustainability-driven materials challenges.
2. Manage industry-oriented projects incorporating environmental and climate considerations.
3. Communicate complex materials and sustainability concepts effectively to technical and non-technical audiences.
4. Demonstrate ethical responsibility in materials innovation and industrial collaboration.
5. Contribute to institutional and industrial sustainability transformation.

3.8 Learning Outcomes Target 8: Industry Collaboration & Real-World Problem Solving

Graduates will be able to:

1. Translate industrial sustainability challenges into materials design solutions.

2. Work effectively with industry partners in project-based and placement environments.
3. Develop research and thesis projects addressing real-world materials problems.
4. Apply multidisciplinary expertise to industry-targeted innovation.
5. Bridge academia and industry to accelerate adoption of emerging materials.

4 Selection and Procedures for Guest Speakers

4.1 General conditions of guest lecturer/invited scholar's engagement

A minimum of two guest lecturers per intake shall be engaged. The minimum duration per engagement of a guest scholar lecturer/invited scholar is one week. A week is defined as a minimum of four working days out of seven consecutive days. Additional guest lecturer/invited scholar positions may be opened by the Governing Board based on need and availability of funds.

The Consortium admits two modes of collaboration with guest lecturers and invited scholars:

Mobility between Consortium Members, in particular from the Associate Partners to the Core Partners and mobility from outside the Consortium, if particularly relevant to **the Programme**.

The Consortium agrees that the guest lecturers/invited scholars shall have two main roles for **MEMSE**:

- a. Contribute to a specific compulsory mobility path;
- b. Contribute to the development of the overall student competencies and skills, in particular in the field of research methods, soft skills and other professional skills relevant for psychologists.

Specifically, the contribution of guest lecturers and invited scholars may consist of, but is not limited to, the following activities: as main activities,

- (1) giving workshops and/or lectures as part of the MEMSE Summer School,
- (2) teaching other short courses,
- (3) participating in the research activities of **the Programme**, and
- (4) contributing to Programme management, in particular curriculum development, transfer of knowledge, network and partnerships development.

4.2 Funding of guest lecturer/invited scholar positions

Guest lecturer and invited scholar positions shall be financed from the Consortium budget, and may be considered either as shared expenses of the Consortium or specific expenses of a Core Partner. Guest lecturers and invited scholars shall sign a Visiting Scholar Agreement with the Consortium.

4.3 Selection of guest lecturers and invited scholars for the Programme

The Consortium may select and invite high profile experts in fields relevant to **MEMSE** to act as invited scholars or guest lecturers for **the Programme**. Invited scholars and guest lecturers are only eligible for guest lecturer positions if they comply with the following criteria:

- (a) Hold PhD degree in a disciplinary field of high relevance to the project and substantial experience in research and teaching at the High Education level, coaching or training;
- (b) OR have a strong professional background in a relevant private, governmental or non-governmental organization combined with substantial experience in teaching at the High Education level, coaching or training;
- (c) Have proficiency in written and spoken English.

4.4 Visiting Scholar Agreement

Each invited scholar and each guest lecturer must sign, prior to the start date of their activities, a Scholar Agreement with the Consortium represented by the Coordinating Institution. The Scholar Agreement may be negotiated individually and shall specify:

- (a) Grant payment modalities and modes of reimbursement of travel, accommodation and other costs;
- (b) A detailed description and a calendar of this scholar's activities within **the Programme**;
- (c) Conditions of annulation of the Scholar Agreement;
- (d) Arrangements in regard to intellectual property rights;
- (e) Required reports from this scholar's activities to the Consortium;
- (f) Contribution to the promotion and dissemination of the MEMSE programme in their HEI and country of origin.

6 Deviation from Original Plan

The submission of this Deliverable was delayed.

7 Conclusions

This Deliverable provided a full Joint Master Programme with integrated teaching activities and three mobilities of students spending at least two semesters at two of the Core Partners in addition to integrated provisions for Spring, Summer Autumn, Winter school with assessments for learner success and evaluation built in with selection of guest speakers, and clear joint delivery by the 3 Core Partners culminating in a joint award. It included learning outcomes, a detailed list of modules and the learning experiences students will undertake. The Deliverable included infographs on the structure of the programme including mobilities and thesis elements. It also provided a template for joint certification.

