Transilvania University of Brașov
INTERDISCIPLINARY DOCTORAL SCHOOL

ADMISSION TO DOCTORAL STUDIES **Session September 2026**

Field of doctoral studies: Materials engineering
Doctoral supervisor: Prof. Dr. Chem. Cătălin CROITORU

TOPICS FOR THE ADMISSION TO DOCTORAL STUDIES

TOPIC 1: *Polymeric Composite Materials and Architectured Structures for Protective Equipment Manufactured by Additive Technologies*
Contents / Main aspects to be considered • Development and optimization of polymeric and composite materials intended for additive manufacturing (FFF/FGF, SLA, SLS), with emphasis on mechanical properties, shock absorption, flexibility, and user comfort. • Design and fabrication of architectured structures (lattice, gyroid, auxetic, graded structures) for use in orthoses, insoles, AFO devices, ankle/knee/spine protective components, as well as in personal protective equipment (helmets, harnesses, lumbar protectors). • Correlation of material composition, processing parameters, and internal architecture with mechanical behavior, shock-absorption performance, pressure distribution, and ergonomic comfort.
Recommended bibliography: Nguyen, K. Q., et al. (2023). *Recycled, Bio-Based, and Blended Composite Materials for 3D Printing Filament: Pros and Cons—A Review.* Materials Sciences and Applications, 14(3), 148–185. Kyriakidis, I. F., et al. (2024). *Mechanical Performance of Recycled 3D Printed Sustainable Polymer-Based Composites: A Literature Review.* Applied Sciences, 8(6), 215.
Prerequisites / Remarks: *Graduate of a Master's program in Materials Engineering, Industrial Engineering, Chemical Engineering, Environmental Engineering, or Mechanical Engineering.*
☒**Scientific Doctorate** ☒**Professional Doctorate**
☒**without tuition fee (state budget funded)** ☒**with tuition fee or with funding from other sources than the state budget**

TOPIC 2: *Advanced Polymeric Composite Materials for Additive Manufacturing*

Contents / Main aspects to be considered

- Investigation and development of new formulations of polymeric and composite materials (including, but not limited to, those based on recycled polymers) suitable for various additive manufacturing technologies (e.g., FDM/FFF, SLA, SLS), with emphasis on sustainability and circular economy principles.
- Strategies for modifying and functionalizing polymeric and composite materials to induce specific properties (enhanced mechanical performance, thermal/electrical conductivity, antimicrobial behavior, self-healing, sensing capabilities, flame resistance, etc.), transforming them into multifunctional or intelligent materials.
- Study of correlations between material composition, additive manufacturing processing parameters, and the morpho-structural, physico-mechanical, thermal, and functional properties of the printed parts.
- Advanced characterization of materials and 3D-printed structures using complementary techniques to evaluate performance under various operating conditions and long-term durability.
- Life-cycle assessment, environmental impact analysis, and safety considerations related to the processing and use of advanced materials and products obtained via additive manufacturing, with relevance for industrial applications and user safety. Exploration and validation of potential applications of the developed functional/intelligent materials in diverse fields (e.g., engineering, medicine, electronics, protective equipment).

Recommended bibliography:

Nguyen, K. Q., et al. (2023). *Recycled, Bio-Based, and Blended Composite Materials for 3D Printing Filament: Pros and Cons—A Review.* Materials Sciences and Applications, 14(3), 148–185.

Kyriakidis, I. F., et al. (2024). *Mechanical Performance of Recycled 3D Printed Sustainable Polymer-Based Composites: A Literature Review.* Applied Sciences, 8(6), 215.

Prerequisites / Remarks: *Graduate of a Master's program in Materials Engineering, Industrial Engineering, Chemical Engineering, Environmental Engineering, or Mechanical Engineering.*

☒**Scientific Doctorate**

☒**Professional Doctorate**

☒**without tuition fee (state budget funded)**

☒**with tuition fee or with funding from other sources than the state budget**

TOPIC 3: *Functional and Intelligent Materials Based on Renewable Resources*

Contents / Main aspects to be considered

- Advanced valorization of renewable resources (various biomass sources, agro-industrial waste, natural polymers) for the synthesis of precursors and material platforms with functionalization potential.
- Development of innovative and sustainable methods for obtaining functional materials (adsorbent, catalytic, antimicrobial, sensing) and intelligent materials (responsive to external stimuli such as pH, temperature, light, electric/magnetic fields) from renewable resources and through the design of polymeric architectures. In-depth study of the physico-chemical, morpho-structural properties and action mechanisms of the newly developed materials using appropriate characterization techniques.
- Exploration of various processing and structuring techniques (including, but not limited to, additive manufacturing, electrospinning, self-assembly) to optimize performance for specific applications.
- Evaluation of the efficiency and applicability of functional and intelligent materials in contexts relevant to environmental protection (e.g., water and air depollution, pollutant monitoring) and industrial safety (e.g., gas sensors, controlled release of active agents, protective systems)

Recommended bibliography:

Patel, S., et al. (2024). *Innovative Adsorbents for Pollutant Removal: Exploring the Latest Research and Applications.* Molecules, 29(18), 4317. Di Mauro, A., et al. (2024). *Functional Bio-Based Polymeric Hydrogels for Wastewater Treatment: From Remediation to Sensing Applications.* Gels, 10(8), 498.

Prerequisites / Remarks: *Graduate of a Master's program in Materials Engineering, Industrial Engineering, Chemical Engineering, Environmental Engineering.*

☒**Scientific Doctorate**

☒**Professional Doctorate**

☒**without tuition fee (state budget funded)**

☒**with tuition fee or with funding from other sources than the state budget**

Doctoral supervisor,

Prof. Dr. Chem. Cătălin CROITORU

Coordinator of the field of doctoral studies,

Prof. Dr. Eng. Mircea Horia ȚIEREAN