ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

MUR DM 117/Lagor-Advanced methods, instruments, & processes for the analysis of the properties of magnetic materials for electrotechnical applications

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] Politecnico di TORINO [P.iva/CF:00518460019] Lagor s.r.l. [P.iva/CF:00254520067]
Supervisor	RAGUSA CARLO STEFANO - carlo.ragusa@polito.it
Contact	
Context of the research activity	Progress in designing and developing efficient electrical machines and inductors for power electronics relies on improved and better-understood magnetic materials. The planned activity will involve experimental and theoretical studies on magnetization and magnetic losses under alternating and rotational fields in Fe-based soft magnetic sheets from DC to the kHz range and developing new measuring instrument prototypes to be embedded in the advanced manufacturing processes of magnetic cores. Progetto finanziato nell'ambito del PNRR – DM 117/2023 - CUP E14D23002000004
	The context of the proposed activity is collaborative research involving the Politecnico di Torino – Department of Energy, Torino, Italy and the manufacturer LAGOR S.r.l. (https://www.lagor.com/en/), Alessandria, Italy. This group has collaborated on soft magnetic materials for energy applications for a few years. Generation, distribution, and conversion of electrical energy pass through magnetic cores, whose energetic efficiency is of the most significant importance to the sustainable exploitation of natural resources, the containment of CO2 emissions, and their undesirable effects on the world climate. For these reasons, progress in designing and developing efficient electrical machines, transformers, and inductors for power electronics, relies on improved and better-understood magnetic materials. In this regard, the advances in magnetic measurement methods, the related accuracy and the normative issues are indispensable tools for the industrial development and commercialization of the materials. Moreover, the widening domains of application and the development of new materials and devices have

Objectives	introduced new phenomenological scenarios and new theoretical and experimental challenges requiring new measuring techniques. As an example, electrical machines operating at high speed for automotive applications or trends towards miniaturization of devices have imposed increasing working frequencies, higher induction levels, complex non-sinusoidal flux waveforms (e.g., magnetic cores in switched-mode power supplies and electronically driven motors), and 3-dimensional magnetic field patterns, bringing about equally complex experimental characterization methods and theoretical models of the core performances. The activity planned for the candidate PhD student will be committed to experimental and theoretical studies on the magnetization process and losses under alternating and rotational fields in Fe-based soft magnetic sheets from DC to the kHz range. In particular, s/he will develop advanced methods of analysis and new measuring instrument prototypes to be embedded in the advanced manufacturing processes of magnetic cores. The proposed research programme, highly innovative, with an industrial connotation, responds to the innovation needs of companies in the electrotechnical sector. There will be periods of study and research abroad and periods of study and research by the manufacturer LAGOR.

Skills and competencies for the development of the activity	Electrical and Electronics Engineers and experimental Physicists interested in electrical engineering, magnetic materials for electrotechnical applications and the measurement of their properties.