

Course Syllabus for
Smart and Sustainable Industry PhD Program
 (years 2024-25 /2025-26)

Course title	Fundamentals of Radio Localization and Sensing
Scientific Discipline Sector	ING-INF/03
Hours of instruction	20 hours
CFU	2 CFU
Semester	First
Goal	The course is designed to knowledge on various aspects of radio localization and sensing using terrestrial wireless systems, from more traditional scenarios up to the new emerging contexts of 5G and 6G cellular systems.
Syllabus	<ul style="list-style-type: none"> • Course overview and fundamentals of terrestrial wireless positioning systems: Introduction of the participants and the course; The role of terrestrial radio positioning as a complementary solution to GNSS • Localization approaches based on time and signal strength information in single-input single-output systems: RSS-based methods; TOA-based methods; Hybrid RSS and TOA-based localization • Localization using antenna arrays in sub-6 GHz systems: cooperative schemes and advanced signal processing approaches for dynamic multipath environments: Basics of antenna arrays for positioning; Dynamic Applications • Localization in 5G mmWave multiple-input single-output systems - accurate low-complexity channel estimation and simultaneous localization and mapping: Sub-6GHz vs mmWave; SISO, MISO, SIMO, MIMO Systems; Array architectures; Channel parameter estimation in MISO 5G Systems; Positioning in MISO 5G Systems; Simultaneous localization and mapping in MISO 5G Systems • Joint localization and synchronization using reconfigurable intelligent surfaces in 6G systems: Ingredients of 6G; Going deeper into RIS; RIS for localization and synchronization; Advanced channel models.
Bibliography	<ul style="list-style-type: none"> - M. Richards, Fundamentals of Radar Signal Processing. 3rd ed. New York: McGraw Hill, 2022. - N. Levanon, E. Mozeson, Radar Signals, John Wiley & Sons, Inc, 2004.
Examination method	Final presentation on selected scientific articles dealing with the topics covered by the course.