

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

<b>Course title</b>	<b>NIR and MIR laser coupling with fibers</b>
<b>Scientific Discipline Sector</b>	FIS/01 – FIS/03 - FIS/07
<b>Hours of instruction</b>	20
<b>CFU</b>	2
<b>Semester</b>	Second
<b>Goal</b>	The goal of the course is to provide students with the basic concepts of how light is guided in optical fibers and how their structure can be optimized to guide near-infrared (NIR) and mid-infrared (MIR) sources.
<b>Syllabus</b>	<ol style="list-style-type: none"> <li>1. <b>Step-Index Waveguides:</b> starting from the scalar Helmholtz equation, hybrid modes HE and EH will be derived in solid core waveguides.</li> <li>2. <b>Hollow Core Waveguides:</b> the propagation of light in void structure will be analyzed, focusing on the several materials employed to realize hollow core waveguides.</li> <li>3. <b>Simulation of Solid and Hollow Core Waveguides:</b> solid and hollow core waveguides will be simulated with COMSOL.</li> <li>4. <b>Laboratory activity:</b> realization of an optical setup for alignment of laser sources with hollow core fibers and measurement of the beam profile of NIR and MIR-coupled sources.</li> </ol>
<b>Bibliography</b>	Clifford R. Pollock, Michal Lipson - Integrated Photonics (2003, Springer) Xingcun Colin Tong - Advanced Materials for Integrated Optical Waveguides (2014, Springer)
<b>Examination method</b>	Report on laboratory activity