

Percorso Autonomo Autorizzato

Title (Titolo)	MATHEMATICAL AND PHYSICAL MODELING FOR NUCLEAR APPLICATIONS (Modellistica Matematico-Fisica per applicazioni nucleari)
Chief (Referente responsabile)	(DENG, PoliMi): prof. Matteo Passoni
Supporting Coordinators (Altri referenti)	(DENG, PoliMi): dr. Alessandro Maffini
Scientific collaborations and partnerships (Collaborazioni scientifiche nazionali ed internazionali)	<p>The Professors involved in this PAA (and more generally in the MSc Program in Nuclear Engineering) have established teaching and research collaborations with prestigious foreign universities such as the Massachusetts Institute of Technology (MIT), the University of California at Los Angeles (UCLA), the Tokyo Institute of Technology (TITECH), the French “Grandes écoles”, the University of Cambridge, Oxford and Durham, the Ecole Polytechnique Federale de Lausanne (EPFL), the Georgia Institute of Technology (GeorgiaTech), the Technical University of Munich (TUM), the Technical University of Delft (TUD). In addition, they have partnerships with prestigious national and international research institutions, such as CNR, ENEA, CERN, JRC, ITU, KIT, JET, ITER. Active collaborations with various departments of Politecnico di Milano, for both teaching and research, can be found as well.</p>
Description and goals (Descrizione ed obiettivi)	<p>This PAA is part of the PSPA (Major) in "Computational Science for Engineering" and aims to suitably develop the skills regarding physical-mathematical models used for the description of complex engineering and physical systems such as, for example, those that characterize nuclear systems and the physics of matter. The PAA in "Mathematical and physical modeling for nuclear applications" aims at combining the peculiar educational features that characterize the LM in Mathematical Engineering with some of the skills associated to the study of the physics of matter and the design of nuclear systems. In particular, the proposed educational program will allow to achieve a suitable preparation to understand and develop skills in areas such as: i) nuclear reactor physics; ii) hot and thermonuclear plasma physics; iii) safety and risk assessment of complex systems, such as nuclear power plants; iv) solid-state and condensed matter physics.</p>
Study Plan (Piano di studi)	<p>The Study Plan is built starting from the PSPA (Major) in "Computational Science", with the addition of courses related to the study of the physics of nuclear reactors (<i>Fission Reactor Physics I</i>), the computational methods used for assessing the safety and reliability of complex systems (<i>Reliability, safety and risk analysis B</i>), plasma physics (<i>Plasma physics</i>) and physics of crystalline solids (<i>Solid state physics A</i>).</p>
Past MSc theses (Alcune tesi discusse)	<ul style="list-style-type: none"> • P. J. Baioni (Ing. Mtm + Ing. Nuc), <i>Theoretical and numerical study of magnetically confined plasmas in linear machines</i>, 2020 • M. Lo Verso (Ing. Mtm + Ing. Nuc), <i>Massively parallel particle-in-cell simulations of laser-plasma interaction : a performance analysis</i> , 2020 • A. Formenti (Ing. Mtm.), <i>Intense laser interaction with nanostructured plasmas : a kinetic numerical investigation</i>, 2016 • M. Rigamonti (Ing. Nuc.), <i>Development of a framework for unsupervised classification of nuclear transients</i>, 2012 • M. Gerosa (Ing. Nuc.), <i>Studio teorico-computazionale sulla propagazione di luce in un materiale gerarchico multiscala</i>, 2012 • S. Piccoli (Ing. Nuc.), <i>Sviluppo di metodi per la descrizione teorica e l'analisi di misure di spettroscopia a scansione per effetto tunnel</i>, 2011 • I. Prencipe (Ing. Nuc.), <i>Studi teorici sull'accelerazione di ioni mediante interazione</i>

	<p><i>tra impulsi laser ultraintensi e materia</i>, 2011</p> <ul style="list-style-type: none"> • A. Balestrero (Ing. Nuc.), <i>Maintenance modeling based on effective age, fuzzy logic and Montecarlo simulation</i>, 2011 • A. Bertagna (Ing. Mtm.), <i>Studio di modelli per l'accelerazione di ioni mediante impulsi laser ultraintensi e ultrabrevi</i>, 2009
Available subjects for a MSc thesis (Tesi e Tirocini disponibili)	Please contact the Professors of the courses which characterize this PAA
Job opportunities (Sbocchi lavorativi)	Every job opportunity related to the LM in Mathematical Engineering with specialization in the PSPA in "Computational Science". More specifically, the education obtained following this PAA, ideally completed with a MSc thesis dedicated to one of its specific areas, will result in a professional profile characterized by a high-level preparation in the field of analytical and numerical modeling of complex systems, suitable to be exploited in many areas of modern industrial engineering, physics / materials science and research.
Second Master Degree in Nuclear Engineering (Seconda LM in Ingegneria Nucleare)	To obtain the LM in Nuclear Engineering, students who got the LM in Mathematical Engineering, with a PAA in "Mathematical and physical modeling for nuclear applications" and a thesis in a nuclear field, must acquire additional 55 credits from courses taken within a third year. In the final examination, the students will be able to bring the same thesis discussed to obtain the MSc in Mathematical Engineering. See the Table below.

Second Master Degree in Nuclear Engineering

CS	SEM	SSD	COD	TEACHING	CFU
LM	1	ING-IND/19	054647	Introduction to nuclear engineering A+B	10
LM	1	ING-IND/20	091720	Radioattività (5 CFU)	10
LM	1/2	ING-IND/19	061398	Radioprotezione (5 CFU)	
LM	1	FIS/03	096300	Introduction to quantum physics (5 CFU)	
LM	1	FIS/03	051086	Fisica Atomica B (5 CFU)	
LM	2	ING-IND/20	094893	Fisica del nucleo (5 CFU)	
LM	2	ING-IND/20	094957	Laboratorio di fisica del nucleo (5 CFU)	
LM	1	ING-IND/20	052591	Radiation detection and measurement	10
LM	1	ING-IND/19	055620	Nuclear Design and Technology	10
LM	1	ING-IND/20 ING-INF/01	057919	Advanced Detection Systems for Nuclear Technologies I + II (10 CFU)	10
LM	2	ING-IND/20	057920	Radiochimica Applicata A+B (10 CFU)	
LM	1	ING-IND/20	097564	Medical Applications of Radiation Fields (10 CFU)	
LM	1-2			<i>Choices from the tables:</i> LM NUC -2A, -2B, -2D, -2E (see the MSc Program in Nuclear Engineering)	5
LM	1-2		097721	Thesis work	15
				Total CFU 3rd year	70

