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): prof. Stefano Agosteo
Scientific collaborations and partnerships (Collaborazioni scientifiche nazionali ed internazionali)	The professors involved in this program (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 École 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 the Politecnico di Milano, for both teaching and research, can be found as well.
Description and goals (Descrizione ed obiettivi)	This program is part of the Major program (PSPA) in *Computational Science and 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 program in *Mathematical and physical modeling for nuclear applications* aims at combining the peculiar educational features that characterize the MSc 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.
Study Plan (Piano di studi)	The Study Plan is built starting from the PSPA in *Computational Science and Engineering*, with the addition of courses related to the study of the physics of nuclear reactors (*Fission Reactor Physics*), the computational methods used for assessing the safety and reliability of complex systems (*Reliability, safety and risk analysis A*), plasma physics (*Plasma physics*) and physics of crystalline solids (*Solid state physics A*).
Past MSc theses (Alcune Tesi discusse)	• A. Formenti (Ing. Mtm.), *Intense laser interaction with nanostructured plasmas: a kinetic numerical investigation*, 2016 • M. Gerosa (Ing. Nuc.), *Studio teorico-computazionale sulla propagazione di luce in un materiale gerarchico multiscala*, 2012 • M. Rigamonti (Ing. Nuc.), *Development of a framework for unsupervised classification of nuclear transients*, 2012 • A. Balestrero (Ing. Nuc.), *Maintenance modeling based on effective age, fuzzy logic and Montecarlo simulation*, 2011 • S. Piccoli (Ing. Nuc.), *Sviluppo di metodi per la descrizione teorica e l'analisi di misure di spettroscopia a scansione per effetto tunnel*, 2011 • I. Prencipe (Ing. Nuc.), *Studi teorici sull'accelerazione di ioni mediante interazione tra impulsi laser ultraintensi e materia*, 2011 • A. Bertagna (Ing. Mtm.), *Studio di modelli per l'accelerazione di ioni mediante impulsi laser ultraintensi e ultrabrevi*, 2009

(Available subjects for a MSc thesis) (Tesi disponibili)	Please contact the professors of the courses which characterize this program.
Job opportunities (Sbocchi lavorativi)	Every job opportunity related to the MSc in Mathematical Engineering with specialization in the PSPA in *Computational Science and Engineering*. More specifically, the education obtained following this program, 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 MSc in Nuclear Engineering, students who got the MSc in Mathematical Engineering, with a program 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

SEM	SSD	COD	COURSE	CFU
1	ING-IND/19	096039	Introduction to nuclear engineering A+B	**10**
1	ING-IND/20	085952	Radioattività (5 CFU)	
1	ING-IND/19	085948	Radioprotezione (5 CFU)	
1	FIS/03	096300	Introduction to quantum physics (5 CFU)	**10**
2	ING-IND/20	085950	Fisica del nucleo (5 CFU)	
2	ING-IND/20	093152	Laboratorio di fisica del nucleo (5 CFU)	
2	ING-IND/20	096045	Radiation detection and measurement (10 CFU)	**10**
2	ING-IND/20	097618	Applied Radiochemistry A+B (10 CFU)	
2	ING-IND/19	096046	Dynamics and control of nuclear plants	**10**
1	ING-IND/20	097564	Medical applications of radiation fields (10 CFU)	
1	ING-IND/19	097616	Nuclear design and technology (10 CFU)	**10**
2	ING-IND/20	097618	Applied Radiochemistry A+B (10 CFU)	
1 o 2			*Choice from the Groups*: NP1, NP2, NT1, NT2, NSP1, NSP2 (see the MSc Program in Nuclear Engineering)	**5**
1 o 2		097721	Final work	**15**
			Total 3rd year	**70**