Department of Mathematics, Computer Sciences, Physics, and Earth Sciences
University of Messina

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'Geophysical Sciences for Seismic Risk'

Degree Class LM-79 (Geophysical Sciences)

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Academic Year 2019/2020

I year

Subject	T.A.F.	CFU	SSD	Semester	Type of lesson	Number of hours	Number of exams
Physics of environmental processes	B	8	FIS/01	I	LT+EL (6+2)	60	1
Applied Geology	B	6	GEO/05	I	LT+EL (4+2)	48	1
Applied Petrography	B	6	GEO/07	I	LT+EL (4+2)	48	1
Advanced algorithms for scientific computing	C	6	MAT/08	I	LT+EL (4+2)	48	1
Additional language skills	F	6		I	LT(6)	36	
Laboratory of Seismic Data Processing and Field Campaign	B	6	GEO/11	II	LT+EL (2+4)	60	1
Environmental Geology	B	6	GEO/04	II	LT+EL (4+2)	48	1
Physics for cultural heritage protection	B	6	FIS/07	II	LT+EL (4+2)	48	1
Geophysical methods for solid and fluid Earth investigation Mod.A - Geophysical Observation Methods and Remote Sensing Mod.B - Oceanography and Ocean Hazard	B	6+6	GEO/10 GEO/12	II	LT+EL (4+2) LT+EL (4+2)	48 48	1
Total		**62**					**8**

II year

Subject	T.A.F.	CFU	SSD	Semester	Type of lesson	Number of hours	Number of exams
Prevention of earthquake disasters Mod.A - Seismic monitoring and surveillance Mod.B - Seismic Risk	B	6+6	GEO/10	I	LT+EL (4+2) LT+EL (4+2)	48 48	1
Dynamics of structures	C	6	ICAR/08	I	LT+EL (4+2)	48	1
Seismo-induced Chemical Risk	C	6	CHIM/04	I	LT+EL (4+2)	48	1
Student choice disciplines and/or activities	D	10					1
Training course	F	6		II			
Thesis	E	18		II			
Total		**58**					**4**

S.S.D. = scientific disciplinary field, TAF = type of training activity, B = distinctive learning activity, C = related or complementary learning activity, D = student choice disciplines, E = graduation thesis, F = others knowledge, LT=Lessons, EL=laboratory and training activity.

Disciplines of the Master's Degree Course in
GEOPHYSICAL SCIENCES FOR SEISMIC RISK

Subject	T.A.F.	CFU	SSD	Summary of Course Content
Physics of environmental processes	B	8	FIS/01	Basic concepts of atmospheric physics, meteorology and climate will be presented with the main implications in terms of environmental problems and risks. Surface and altitude measure techniques, numerical models for meteorological analysis, and physical modeling of dispersal processes will be presented (with applications to environmental pollution, volcanic ash trajectories, and other subjects implying natural and anthropic risks). Quantitative climate models for simulating the interactions of climate drivers, including atmosphere, oceans, land surface and ice, will be discussed.

Physics for cultural heritage protection	B	6	FIS/07	Physical methodologies applied to the study, conservation and restoration of cultural and architectural heritage, with particular regard to natural stones (building stones) and artificial stones (mortars, plasters, bricks, ceramics): X-ray analysis, FT-IR and Raman spectroscopy, neutron-based and synchrotron-based techniques, mobile instruments. Conservation strategies, new consolidating and protective materials. Some case studies employing one or more analytical methods.
Environmental Geology	B	6	GEO/04	Geology, geological risks and land planning. Application of geological knowledge to emergency planning. Slope dynamics, landslide classification, seismoinduced landslides. Different level seismic microzoning. Coastal dynamics, erosion risk. Tools and algorithms for analysis of geological and territorial data, GIS applications.
Applied Petrography	B	6	GEO/07	Natural stone materials of ancient and modern use (Granites, Marbles and Stones), extraction, processing and use in the field of buildings. Artificial stone materials (aggregates, ceramics, cements and glass), raw materials, modern production and use technologies. Mineralogical-petrographic study of natural and artificial stone materials using optical microscopy, electronic microscopy, diffractometry and X-ray fluorescence. Determination of the physical-mechanical characteristics. Processing of mineralogical-petrographic and physical-mechanical data and their graphic representation.
Applied Geology	B	6	GEO/05	The course is aimed at giving the students proper information on geologic and tectonic structures and processes having direct implications in terms of seismic risk. Application of Geology to risk mitigation through (i) identification of outcropping seismogenic faults and (ii) analysis of rock and soil properties of greatest interest for Geophysics and Civil Engineering, are major subjects of the Course. Analyses of these properties will be supported by in-situ and laboratory investigations.
Seismic monitoring and surveillance	B	6	GEO/10	The course deals with the science and technology at the basis of seismic observatory and monitoring centers. Various types of seismometric devices and seismic networks at local, regional and global scale are described. Real-time and off-line analyses of earthquake parameters for seismic surveillance and research will be widely discussed. The course covers a wide range of topics from seismic monitoring to Early Warning and Prediction.
Geophysical Observation	B	6	GEO/10	The course covers various geophysical methodologies for modeling of Earth's structure and dynamics.

Methods and Remote Sensing				Methods furnishing information useful for geodynamic modeling, seismogenic fault detection and seismic source characterization are presented. The student will become familiar with data analysis and interpetation in the fields of gravimetry, geomagnetism, active and passive seismology, GNSS and remote sensing, among others.
Seismic Risk	B	6	GEO/10	Joint analysis of seismic, geophysical and geological data for characterizazion of seismogenic structures and dynamics. The seismic signal from source to ground. Instrumental and historical earthquake catalogs. Probabilistic and deterministic estimates of seismic hazard. From seismic hazard to seismic risk. Maps of seismic hazard and risk. Use of seismic hazard and risk estimates for territorial planning and Civil Defense applications.
Laboratory of Seismic Data Processing and Field Campaign	B	6	GEO/11	The study-unit aims to give students a good overview of the geophysical methods used in scientific and commercial exploration as well as in microzoning studies. It will provide the students with hands-on experience in geophysical surveying and give them confidence in planning and conducting appropriate surveys. Students will become familiar with software packages and modern methods for geophysical surveying (active and passive seismology through seismic arrays, analysis of ambient vibrations, georesistivity methods).
Oceanography and Ocean Hazard	B	6	GEO/12	The course investigates the structure and the dynamics of the Earth's oceans at different spatial and temporal scales. Describes the formation and physics of waves. Explains, in particular, the origin of tsunami waves, their travel and coast inundation dynamics. Different sources of tsunami waves analyzed with the support of examples from the Mediterranean region. Tsunami hazard and risk estimates are presented together with prevention strategies.
Seismo-induced Chemical Risk	C	6	CHIM/04	The course deals with risk analysis and mitigation in chemical and energy production in relation to seismic hazard. The course objective is to provide the basic knowledge to assess the seismic risk component associated with hazardous material release from chemical plants. The course will introduce to chemical production and related risk analysis and mitigation, with elements on the system vulnerability and process safety management.
Dynamics of structures	C	6	ICAR/08	The course aims to give the essential theoretical knowledge for understanding and interpreting the fundamental effects of natural dynamic actions on the

				structures. In particular, starting from the study of the simple oscillator and arriving to the multi-degree-of-freedom systems, will be clarified as these effects depend both on action and structure properties. The student will deeply understand the use of seismic data and models made by civil engineers.
Advanced algorithms for scientific computing	C	6	MAT/08	This course enables students to gain skills in the use of numerical algorithms and their implementation in scientific computing, and to mature a critical analysis of the results.
Student choice disciplines and/or activities	D	10		
Training course	F	6		
Thesis	E	18		
Additional language skills	F	6		This frame of activities is, in general, aimed to give basic knowledge on Italian language to non-Italian students and additional knowledge of English language to Italian students. Requests of teaching activities concerning other EC languages advanced by the students who do not need the above skills will be closely considered for realization. The activities include lessons, preparation and oral presentation of technical-scientific reports and debate.
Total		**120**		