General information		
Academic subject	**GEOLOGY**	
Degree course	Environmental Sciences	
Academic Year	I	
European Credit Transfer and Accumulation System (ECTS)		8 CFU
Language	Italian	
Academic calendar (starting and ending date)		1st March – 6th June 2022
Attendance		

Professor/ Lecturer	
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Department and address	Dipartimento di Scienze della Terra e Geoambientali
Virtual headquarters	Link: https://bit.ly/3AJzssh Teams Code: hc2r32b
Tutoring (time and day)	Monday (8:40 - 10:20 AM) - UniBA Paolo VI Taranto or online on Teams (please book a meeting by mail)

Syllabus	
Learning Objectives	The main aim of this course is to provide the student a basic knowledge of the physical system of the planet Earth. Each part of the program is designed to reinforce the student's ability to recognize the foundations of the scientific method by clearly distinguishing data, interpretations, models and theories. The classic topics of Earth Sciences are transferred in the perspective of the recent-current evolution of our planet by seeking continuous links with the environmental dynamics in progress. The general objective of the teaching therefore also involves understanding the continuous interaction between physical and chemical-biological processes in an interdisciplinary context which is typical of the class degree L32.
Course prerequisites	The reliable achievement of main educational objectives requires the student knowledge acquired i) in the teachings of the first semester (essentially Physical Geography) and ii) generic skills in scientific subjects. Working and non-attending students possess these prerequisites in a very similar way to attending students.
Contents	**Introduction** Geology and Earth Sciences. The fields of Geology. The different scales of analysis of geology. Plate tectonics and its most evident consequences (distribution of continents and oceans, seismicity, volcanism, etc.). Geology in the study of the environment. **Part I - Geodynamics and relationships between tectonics and sedimentation** *Internal structure of the Earth.* The concentric envelope model of our planet. Average density, composition of meteorites and propagation of seismic waves. Chemical and rheological characteristics of the lithosphere, asthenosphere and nucleus; depth and nature of the main discontinuities. Concept of isostasis and main consequences (the root of mountain ranges, uplift and subsidence, isostatic rebound and related seismicity). *Plate Tectonics*. From "Continental Drift" to "Plate Tectonics". Lithospheric plates. Inversions of the magnetic field and age of the ocean floor. Types of plaque margins and their localization. Divergent, convergent and transform margins.

	Divergent Margins. Formation of a divergent margins; morphology of ocean floors, age and rate of expansion; deep sea sediments (limestone and radiolarite); hot spot and guyot. Passive margins; seismic sections on passive margins; sedimentary units and pre-, syn- and post-rift phases. Converging margins. Type-B subduction: marianne type systems (island arc) and cordillera type systems (Andean or Chilean). Type-A subduction: tectonic styles in the main ranges (Himalaya, Alps and Apennines). The foreland basin. Margins transform. Definition of transform margin. Transform margins and strike-slip faults: differences. Oceanic lithosphere, age, density and elevation of the oceanic lithosphere. Distribution of transform margins. The Engine of Plate Tectonics. *Basic elements of structural geology*. Geodynamics and Structural Geology. Stress and strain in Physics. Elastic and plastic field. Brittle and ductile behavior as a function of lithology, pressure and temperature in the lithosphere. Brittle tectonics. Classifications. Geodynamic domains and brittle tectonics: relations between tectonics and sedimentation. Ductile tectonics. Classifications. Geodynamic domains and ductile tectonics: relations between tectonics and sedimentation. **Part II - Sedimentary basins and Stratigraphy** *Sedimentary Basins*. Definition of sedimentary basin. Classifications, type of substrate, geodynamic system. The parameters that affect the geometry and type of sedimentary basin infill: sedimentation rate, subsidence rate, basin geometry and accommodation space, eustatic variations, climate. Foredeep basins, rear-arc basins, rift, post rift and passive margin basins, cratonic basins (for strike-slip basins, pull-apart basins). *Stratigraphy*. Introduction to Stratigraphy. Criteria (lithological, paleontological, magnetic, etc.) for the stratigraphic subdivisions. The four principles of Stratigraphy (superposition, original horizontality, lateral continuity, intersection). Principle of Actualism. Principle of Catastrophism. The geometric relationships between the stratigraphic units. Concordance, continuity, hiatus induced by non-deposition or erosion. Definitions of angular unconformity, paraconformity, disconformity. The reports of onlap, toplap and downlap. Exercises on geometric relationships between stratigraphic units, erosional surfaces, tectonic deformations and magmatic intrusions / effusions. Lithostratigraphy: definition; lithostratigraphic units; Formations, Groups, Members and strata. Biostratigraphy: definition; fossils in rocks; the register of evolutionary theories; fossils and sedimentary rocks, the lateral (limited) and vertical (over time) distribution of fossils; the biozones, paleontological criteria for the definition of the various biozones and limitations of the biostratigraphic method (reworked and infiltrated fossils and the significance of condensed sections). Magnetostratigraphy: notes on the magnetization of rocks and the cyclical process of inversion of the earth's magnetic field; magnetostratigraphic units, units of magnetic polarity; polarity zone, sub- and super-polarity zones; observation of periods of magnetic polarity in a time scale. Chronostratigraphy and Geochronology: definitions. Formal nomenclature of the Chronostratigraphic units and of the corresponding Geochronological units. Concept of relative dating and absolute dating. Numerical dating with unstable isotopes. Half-life periods and fields of application. Materials to sample for dating. Time scale: generality and duration of the main geochronological units (eg Phanerozoic, Mesozoic, Quaternary, Pleistocene, Holocene). The causes of glaciations, Cyclostratigraphy and UBSU: the first studies on Glaciations. The Alpine Glaciologists. Causes of Glaciations. Milankovitch's cycles: precession, obliquity, eccentricity. Other causes of climate change: sunspot activity, volcanic eruptions, emission of greenhouse gases. The signal of stable isotopes. The isotope ratio of oxygen. Paleotemperature and volumes of the seas. Glacioeustatic curves. Cyclostratigraphy. Principles of cyclostratigraphy and meaning of cyclicality in sedimentary successions. UBSU. Definition, significance of discontinuity: application of the meaning of the surfaces of unconformity, disconformity, paraconformity, angular unconformity. Principles of Sequential Stratigraphy: definition of sequence. Stratigraphic discontinuities and sequence boundary. The concept of accommodation space as a function of glacioeustatic variations and subsidence. The depositional systems (system tract). Notes on sedimentary environments. Definition of sedimentary environment. Subdivision of sedimentary environments. Overview of erosion, transport and sedimentation processes in continental, transitional and marine environments. *Reading the Geological Maps*. Generality. Rules on the relationships between stratigraphic contacts and topography. The Geological Map: the central body, the legend, the geological sections, the scheme of the stratigraphic relationships. Examples of thematic geological cartography.

	Part III – Hands on and laboratory activities Introduction. Recognition of rocks. Definition of rock. Minerals and crystals. The lithogenetic cycle and plate tectonics. Elements of mineralogy of silicates. The most common silicates and their macroscopic recognition and hints on their microscopic recognition. Leucocratic and melanocratic silicates. Igneous or Magmatic rocks. Origin of magmas and composition. Intrusive igneous rocks: texture / structure, size of minerals, color index M, paragenesis. Classification diagrams. The effusive igneous rocks. Outline of lava and explosive eruptions and their relationship with chemistry, viscosity, gas content and geodynamic context. Afiric and porphyric textures. Classification of volcanoclastic rocks: size of clasts and cohesion of deposits. Sedimentary rocks. Diagenesis and components of a sedimentary rock (grains, pores, matrix and cement). The genetic classification of sedimentary rocks: 1) Terrigenous, clastic rocks; 2) Chemical rocks; 3) Biogenic rocks; 4) Residual rocks. The terrigenous or clastic sedimentary rocks. Particle size classes. Classifications of conglomerates (para- and ortho-conglomerates; polygenic conglomerates and monogenic conglomerates). Classifications of sandstones (arenites and greywackes - quartzarenites, arcose and lithic sandstones). Classification of silt and clays (outline). Evaporites, recognition of the minerals of rock salt, gypsum (anhydrite) and carbonates of chemical origin (calcite and dolomite). The speleothems. The pressure of the carbon dioxide in the percolating solutions. Karst and formation of stalactites and stalagmites. The role of temperature and biogenic action: travertines. Biogenic rocks. The growth of the reefs. Main textural features. The residual rocks. Soils and notes on pedogenesis. Bauxite deposits, red earths and pisolites. The carbonate rocks. Present-day and "fossil" environments with carbonate sedimentation. The role of biological activity. Examples of past and present-day reefs. Classifications of carbonate rocks: compositional (limestone, dolomite, marl); granulometric (calcirudites, calcarenites and calcilutites); Folk (meaning of nature of the allochemicals, ooids, peloids, intraclasts, bioclasts), micrite and sparite, the Biolithites; Dunham (grain-backed and micrite-backed texture), le Boundstone. Notes on metamorphic rocks. Macroscopic recognition of some metamorphic rocks (marble, micascist, gneiss and serpentinite).
Books and bibliography	*Slides and diagrams of classification + Books*: Grotzinger, J.P., Jordan, T.H. (2016). Capire la Terra. Zanichelli, 736 pp. Bosellini, A. (1978). Tettonica delle Placche e Geologia. Zanichelli, 144 pp. Bosellini, A., Mutti, E., Ricci Lucchi, F. (1989). Rocce e successioni sedimentarie. UTET, 396 pp.
Additional materials	*Additional literature material*: Doglioni, C. (1991). Una interpretazione della Tettonica Globale. Le Scienze, 270, 32-42. (PDF). Doglioni, C. (1994). Elementi di tettonica. Il Salice. 162 pp. (PDF) Germani, D., Angiolini, L., Cita, M.B. (2002). Guida Italiana alla Classificazione ed alla Terminologia Stratigrafica. Quaderni APAT, serie III, vol. 9. (2 file in PDF).

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
93	54	39	107
ECTS			
8	6	1 (hands on) + 1 (field trips)	

Teaching strategy	
	The teaching uses three ways of providing knowledge. - The lectures are delivered with .ppt presentations and with the aid of diagrams and demonstrations drawn on the blackboard. - In the exercises, slides with projected classification schemes are used. Students compile reports for each exercise by recognizing rock samples or describing geological maps. Correction occurs collectively. - In the field days, regional maps and charts are used and students produce written reports in small groups. Correction occurs collectively.
Expected learning outcomes	

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Knowledge and understanding on:	The expected results essentially concern the knowledge of the processes connected to the dynamics of the Planet Earth. The tools of the scientific method applied to the understanding of endogenous and exogenous processes are provided. The course is divided into theoretical lessons, laboratory and field exercises (excursions) in order to increase the student's ability to understand the scale and magnitude of the physical processes of our planet
Applying knowledge and understanding on:	Acquisition of skills related to the application of theoretical concepts learned to the temporal and spatial evolution of geological processes. This expected capacity must be the result of practical experiences and exercises in the laboratory and on an excursion, at the end of which the student is asked to prepare reports, descriptive and interpretative schemes.
Soft skills	*Making informed judgments and choices* Acquisition of the ability to identify the methodologically adequate paths to describe, interpret and discuss the complex interactions between geological processes. Group and then individual corrections of the reports related to the exercises are aimed at improving the student's autonomy. *Communicating knowledge and understanding* The student is expected to acquire the ability to discuss the fundamental concepts of the study topics in a clear and comprehensive way, using an appropriate scientific language. The discussions during the theoretical lessons and the reports relating to the exercises contribute to the achievement of this objective. *Capacities to continue learning* The expected results concern the ability to integrate basic knowledge through personal in-depth courses. This objective is also pursued through examples of finding web resources with rigorous scientific material.

Assessment and feedback	
Methods of assessment	The student evaluation includes: - a written test relating to the analytical description of rocks or geological sheets. The written test lasts 2 hours and consists of a short report. This test does not take place if the student passes the exemptions on the same topics that take place during the course; - an oral exam which generally consists of three questions relating to different topics of the course: the oral exam never exceeds thirty minutes. The exam score is expressed out of thirty.
Evaluation criteria	*Knowledge and understanding* The student must demonstrate to master the concepts related to the dynamics of our planet. Endogenous and exogenous processes must be described with particular reference to time and space scales. *Applying knowledge and understanding* The student is asked to apply the essentially theoretical aspects acquired in the course to exogenous or endogenous processes of great importance (eg distribution of earthquakes, volcanism, karst collapses, etc.). *Autonomy of judgment* The student is able to independently identify a logical path between causes and effects in geological processes. The student demonstrates that he is able to choose methodological approaches suitable for describing / solving geological processes / problems. *Communication skills*

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	The student must have acquired the ability to fully communicate the concepts learned and to use correct scientific language. *Capacities to continue learning* The student must demonstrate that he has acquired the tools to enrich his knowledge also through the individual and group in-depth courses proposed during the course.
Criteria for assessment and attribution of the final mark	The exam score will also take into account the evaluation obtained by the student in the exemptions during the course and his active participation in laboratory and field exercises. An excellent grade will be the result of the satisfaction of most of the analytically described evaluation criteria.
Additional information	

Bari, 22/09/2021

Signature

(Prof. Massimo Moretti)