UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare
ACADEMIC YEAR	2019/2020
BACHELOR'S DEGREE (BSC)	GEOLOGY
SUBJECT	PETROGRAPHY WITH LABORATORY
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50189-Ambito mineralogico-petrografico-geochimico
CODE	05674
SCIENTIFIC SECTOR(S)	GEO/07
HEAD PROFESSOR(S)	ROTOLO SILVIO GIUSEPPE Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	10
INDIVIDUAL STUDY (Hrs)	158
COURSE ACTIVITY (Hrs)	92
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**ROTOLO SILVIO GIUSEPPE** Wednesday 12:30 14:30 Studio Prof. Rotolo Thursday 12:30 14:30 Studio Prof Rotolo

DOCENTE: Prof. SILVIO GIUSEPPE ROTOLO

PREREQUISITES	Familiarity with the contents of the courses of Chemistry and Mineralogy
LEARNING OUTCOMES	1) KNOWLEDGE AND UNDERSTANDING Knowledge of the composition of the Earth's interior and rocks of inaccessible Earth. Classificatoin of igneous and metamorphic rocks on the basis of their structural, textural and mineralogical characters. 2) APPLYING KNOWLEDGE AND UNDERSTANDING Ability to encircle macro and microscopic observation in a common mainframe inclusive of familiarity with rock analyses and their geodynamic context. 3) MAKING JUDGEMENTS. capacity to assign a specific geologic environment the given rock and to interpret the geological inferences 4) COMMUNICATION SKILLS ability to explain geological implications and the connection between observations (micro and macroscopic) even to an audience without geological background. 5) LIFELONG LEARNING SKILLS ability to link in an unique mainframe, theory, technology and practice .
ASSESSMENT METHODS	Constant attendance of lessons and labs is matter of positive evaluation. 1) 'In itinere' assesment (not mandatory) focused on exercise on binary and ternary diagrams (Cooling and/or heating a given composition). 2) Final oral examination, including: a)microscopic identification of 2 thin sections of rocks: optical characteristics of minerals, classification, petrogenesis b)identification of 2-3 macroscopic rock samples and related petrogenetic inferences. c)In depth discussion about arguments developed throughout the course. Will be positively evaluated the comprehension of processes and the capacity to present them in an unique mainframe. The examination consists of a minimum number of 8 main questions (open answers) aimed to ascertain the correct use of technical language, capacity of autonomous thinking and crytical perspective. The requirements for minimum evaluation are as follows: classification and positioning in the geological-petrographic context the macro and micro scopic rock samples; easiness of the linkages among the arguments of the course. The higher the degree of interconnection among the arguments of the course, the higher the evaluation ranking.
EDUCATIONAL OBJECTIVES	The principal educational aim of the course is the acquisition integrated view of theorytical aspects with those involving rock observation-classification-interpretation. Specific aims: - the hidden history of a rock in thin section or macroscopic sample: - petrogenetic processes of igneous and metamorphic rocks; - integrated view between phase diagrams and magmatic rocks.
TEACHING METHODS	- Lectures. - Laboratory of macroscopic and microscopic petrography, focused on igneous and metamorphic rocks (classification, petrogenesis). - Field excursion.
SUGGESTED BIBLIOGRAPHY	Si sottolinea l' importanza della frequenza, peraltro obbligatoria, di lezioni e laboratori: Il testo consigliato qui di seguito racchiude le linee generali dello studio della Petrografia, ma non gli sviluppi e gli approfondimenti che si intrecciano e sorreggono la parte piu' rilevante del corso, costruita introducendo i risultati di articoli scientifici innovativi ed esperienze di ricerca del docente. - testo generale: Morbidelli L . Le rocce ed i loro costituenti. - Atlante microscopico: http:// alexstrekeisen.it

SYLLABUS

Hrs	Frontal teaching
2	Classification of igneous rocks on the basis of: mineral abundance, chemistry and CIPW norm. The importance of the composition of solid solutions as a proxy for magma composition. Classification of gabbroic rocks.
1	Structure of the Earth from the petrographic viewpoint. The contribution of experimental petrology.
2	Experiments on mantle peridotites in a historical perspective. Ringwood's experiments on germanates. The modern machines for high pressure experiments: piston-cylinder and multianvil presses.
2	The discovery of high pressure upper and lower mantle minerals (, Wadselyte, Ringwoodite, Majorite, Mg-perovskite). The diamond anvil cell and post-perovskite phase.

SYLLABUS

Hrs	Frontal teaching
1	The outer and inner core: experiments with shock waves. Determination of the solidus of the Earth's core.
3	Classification of ultramafic rocks. The mantle adiabat. Partial melting of lherzolite. Refractory rocks and partial melts and the control on degree of melting. Primary magmas: chemical characterization. Picrites and komatiites. The primordial magma ocean.
2	Structure of silicate melts. H_2O and CO_2 dissolution in silicate melts, effects on magma viscosity/polymerization. Volatile saturation and their influence on crystallizazion paths. Physical characteristics of magmas and their relatioships with melt composition, temperature and H_2O content.
2	Magma crystallization, dry and wet solidus. Clapeyron relation. Crystalliation due to cooling and due to decompression. Undercooling and related mineral textures. Phase rule applied to 2-component systems.
2	T-X 2 component systems characterized by solid solutions. Equilibrium and fractional crystallization. The significance of mineral zoning: inferences on magma feeding system.
1	T-X Two components systems with eutectic. From phase diagram to the thin section: cotectic coprecipitation.
2	Two components systems with peritectic point. Enstatite incongruent melting and its broad-scale petrogenetic significance (basalts over- and undersaturated in silica).
1	Two components systems with azeotropic point. Sub-solidus immiscibility. Perthites.
2	Three components T-X systems: generalities. Diopside-albite-anorthite; diopside-anorthite-forsterite. forsterite-diopside-enstatite. Heating and cooling.
2	Crystallization and melting exercises on binary and ternary diagrams.
2	Magma differentiation processes: fractional crystallization, immiscibility, assimilation. The role of oxygen fugacity on iron-bearing minerals.
1	Magma crystallization stages. The importance of pegmatites and hydrothermal crystallization.
2	Trace elements: compatible and incompatible. Distribution coefficients. Modeling of fractional crystallization and partial melting. RAre earth elemnts and chondrite normalization.
1	The isotopic system Rb/Sr in igneous petrology: depleted and eriched mantle sources. The $^{87}Sr/^{86}Sr$ ratio in primary magmas (MORB, OIB, HAB, CFB). The AFC process.
1	Geometries of magmatic bodies. Pyroclastic rocks. Ignimbrites and their significance.
1	Magmatic series and their relationships with plate tectonics, Discriminating diagrams.
2	Magma production at mid ocean ridges. MORB and alkaline basalts. Ophiolites. OIB magmatism: petrography, trace elements and isotopic characterization.
3	Arc magmatism and andesites petrogenesis. The modified mantle. Calcalkaline and shoshonitic series. Super-volcanoes tied to subduction. Amphibole stability in CA magmas and its breakdoen during magma ascent.The H_2O transport in the deep mantle. The fate of the subducted slab. Nominally anhydrous minerals in the deep mantle: the hidden H_2O reservoir.
2	Within plate magmatism, continental flood basalts. Peralkaline magmas and the petrogenesis of pantellerites. Plio quaternary magmatism in Sicily.
2	Carbonatites and carbonated mantle. Stability of carbonates in lherzolite subsolidus. Carbon speciation in the Earth's mantle as a function of P and fO_2. Kimberlites and their significance. Diamond formation. Moissanite.
2	Petrography of granitoid magmas and their classification schemes. I and S granites. Anatexis. Alteration processes of granitic rocks . The residual system and the phonolite minimum. The importance and occurence of leucite in Italian magmatism.
2	The Moon: mare basalts and anorthosites. The moon magma ocean. Meteorites: classification and importance as proxies for inaccessible Earth (chondrites, pallasites, siderites). Tektites and fulgurites.
2	Classification of arenitic rocks. Clays and clay minerals. Structural classification of clay minerals. X-ray diffractometry. Bauxites and laterites.
3	Metamorphic processes. Foliation and lineation. Ralationships between crystallization and deformation. Mylonites. Nomenclature of metamorphic rocks.
3	Index minerals. facies and isograds concepts. Regional metamorphism. Metamorphism and geodynamic setting.
2	Metamorphic reactions : dehydration, decarbonatation, partial melting. The role of fluid composition (X_{CO_2}, X_{H_2O}) on reaction rate and progress . The Clapeyron relation applied to metamorphic reactions: Clapeyron slope and its significance in devolatilizaion reactions. The phase rule applied to metamorphic reactions. Examples and exercises.
2	Metamorphism of pelitic rocks. Anchimetamorphism and Illite cristallinity index. The amphibolite facies minerals in metapelites. Kaolinite-out e muscovite-out reactions. Anatexis and migmatites. Granulites
2	Metamorphism of mafic rocks. Zeolite facies. Amphibole compositional variations with metamorphic grade. Mafic granulites. High and very high pressure metamorphism, blueschists and eclogites.

SYLLABUS

Hrs	Frontal teaching
1	Metamorphism of calcareous rocks. Decarbonatation reactions and the importance of fluid composition (XCO2).
3	P-T-t paths, theory and applications to microstructures. Metamorphic basements in Italy: Alps, Sardinia, Calabria-Peloritani orogen.

Hrs	Workshops
1	Generalities on Scanning Electron Microscopy and EDS spectra. X-Ray diffractometry. X-Ray fluorescence. General criteria for macro- and microscopic description of rocks. Microscopic determination of evolution of the given magamtic rock on the basis of solid solution minerals (particularly pyroxenes).
20	Study of more than 50 macroscopic samples of magmatic rocks. Classification,petrogenetic aspects, Thin section study of around 10 samples of igneous rocks, with description of their geological context and crystallization history.
1	Arenaceous rocks in thin section and macroscopic samples.
14	Macroscopic study of more than 30 samples of metamorphic rocks: (a) protolith, (b) metamorphic conditions, (c) type of metamorphism. Study in thin section of 7 metamorphic rocks: (i) classification, (ii) protolith, (iii) metamorphic facies, (iv) whenever possible: P-T-t paths.