Course Descriptions of Mineral Resources Engineering Curriculum, 2021-2022

Code	Title	Description	sem.	ECTS
LANG 101	ENGLISH I	The course recapitulates grammar details and vocabulary of level B2 general English and emphasizes the learning of the basic academic vocabulary. It aims at the development of skills for the comprehension of authentic and for writing formal letters of academic and professional nature. The course employs real texts of specialised level B2 content, essays and online computer tests, and exercises at the Center for Language Research and Resources.	1	2
LANG 102	ENGLISH II	Further learning of level C1 grammar and vocabulary, and advanced academic vocabulary. The course aims at the development of writing skills and comprehension of written and oral language. The course employs authentic texts of specialised level C1 content, essays and online computer tests, and exercises at the Centre for Language Research and Resources.	2	2
LANG 103	GERMAN I	Simple german language course for students who already have a basic level knowledge of the language. The course pursues the development of writing and oral skill in practice. An introduction and use of strategies to comprehend written text is followed by processing authentic texts of contemporary everyday life. Exercises are conducted for the enrichment of the vocabulary and select grammatical subjects. There is audiovisual material for self-learning, on-line exercises at the site of the Language Centre and virtual classes.	1	2
LANG 104	GERMAN II	The course has a character of in-depth learning and pursues the enhancement of the skills acquired at LANG 103. The course aims at the development of the ability of the student to process and comprehend several types of text, at extending of the vocabulary and producing written and oral word. Special emphasis is given to the aural comprehension. The description of the structure of the sentences and the ability of composing them in the german language is a central point of reference for the grammar.	2	2
LANG 201	ENGLISH III	The course aims at learning specialised vocabulary relevant to several courses of the Faculty, such as Strength of Materials, Geophysics (seismic theory), Mechanics, Rock Mechanics and Physical Processes. The course is based on texts and exercises of authentic texts and is centred on the development of advanced skills of text and specialised lecture comprehension, as well as, of the ability to summarise long scientific texts. The learning material includes teacher's notes and computer exercises.	3	2
LANG 202	ENGLISH IV	The course aims at learning specialised vocabulary relevant to several courses of the Faculty, such as Geophysics, Solid Mechanics, Exploitation, Mineralogy etc. The course is based on texts and exercises of authentic texts and is centred on the development of advanced skills of text and specialised lecture comprehension, as well as, of the ability to write one's ideas on scientific subjects. The learning material includes teacher's notes and computer exercises.	4	2
LANG 203	GERMAN III	The course gives emphasis to the introduction in specialised terminology in the written and the oral word. The objective is the reading, the processing and the critical comprehension of several texts (articles, technical texts) that are immediately related to the terminology of the Faculty of Mineral Resources Engineering. The forms and the structure of composing written word are extended. Special emphasis is given to the aural comprehension.	3	2

Code	Title	Description	sem.	ECTS
LANG 204	GERMAN IV	The course aims at learning the specialised german vocabulary relevant to the terminology used at the Faculty, by using scientific texts, at the improvement of writing skills and at the rounding of the frame of thinking, managing, and functioning in a german speaking scientific environment. Special emphasis is given to the aural comprehension and to the production of oral/written word, in order to obtain higher fluency in international communication.	4	2
KEP 102	POLITICAL ECONOMY	Includes an analysis of basic notional categories and relations in Political Economy, as well as a brief review of recent economic history. Particular references are made to: the theory of valuation, surplus value, pricing, the relationship between competition and distribution, the fundamental trends and incongruities of amplification, and financial crisis phenomena.	2	4
KEP 104	INTRODUCTION TO PHILOSOPHY	A brief overview of the history of philosophy. Main categories and laws of the dialectic in the areas of knowledge. Theory of ontology and logic (formal and dialectical). Elements of social philosophy. The social structure as an organic whole, social consciousness and its forms.	2	4
KEP 201	MICRO/MACRO ECONOMICS ANALYSIS	Analysis of commodity supply and demand, consumer theory and corporate theory. On a macroscopic level the issues analyzed include the income and employment determination, inflation, the role of investments, and the problems or development trends within the world economy.	3	4
KEP 202	HISTORY OF CIVILIZATION	Using basic knowledge of social sciences (sociology, anthropology, philosophy, political economy etc.) and theoretical approaches as a departure point, an analytical and synthetic approach is used to investigate issues related to the history of civilization as a whole (the relationship between material and spiritual civilization) as well as for specific periods (Antiquity, Middle Ages, Renaissance and transition to modernity, modernity etc.). Issues of modern civilization are underlined, combined with a critical approach on certain theories that attempt to interpret modern civilization (behaviorism, postmodernism, etc.)	2	4
KEP 204	INTRODUCTION TO THE TECHNICAL LEGISLATION	Introduction to legal systems (the role of law, the legal theory of state, ASP of human rights), industrial relations (introductions to the individual contract of employment, trade union rights, collective bargaining, industrial accidents and hygiene and safety at work), introduction to the law of environment protection (principles of environment protection constitutional and general law protection), introduction to the law of natural resources (principles of rights for exploration and exploitation of natural resources in the constitution and the general law).	3	4
KEP 302	INDUSTRIAL SOCIOLOGY	Lectures on Sociology of Labor and Sociology of Development, with particular reference on the historical approach of production systems and on recent changes concerning industry in relation with other sectors of economic and scientific activities. Analytic and synthetic approach on different levels (international, national, regional-local), concerning crisis and restructuring strategies, “flexible” production and labor organization, labor market, industrial relations, inter-firm relations, local production systems, research and technological development, innovations, know-how, industrial policy. In addition, classical and modern theories of organization and management within their historical/social framework are studied.	2	4

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MATH 101	DIFFERENTIAL & INTEGRAL CALCULUS I	Functions of one variable (Lines, Graphs, Combination, Sifting and Scaling, Trigonometric and Hyperbolic Functions, Inverse Functions). Limits and continuity. Differentiation (Derivative at a point and as a function, Differentiation Rules, Chain Rule, Implicit Differentiation, Differentials). Applications of derivatives (Extreme Values, Mean Value Theorem, Monotonicity, Concavity, Antiderivatives). Integration (Indefinite Integrals, Substitution Method, Riemann Sums, Definite Integrals, Fundamental Theorem of Calculus). Applications of Definite Integrals (Areas, Volumes, Arc Length, Surfaces of Revolution, Work). Transcendental Functions (Derivatives and Integration of Logarithmic, Exponential and Hyperbolic Functions and their inverses). Separable First Order Differential Equations. Techniques of Integration (Integration by parts, Trigonometric substitutions, Partial Fractions). Improper Integrals. Infinite Sequences and Series.	1	5
MATH 102	DIFFERENTIAL & INTEGRAL CALCULUS II	Vectors. Equations of surfaces and solids. Polar, cylindrical and spherical coordinates. Parametric representation. Dot and cross vector products. Multivariable functions. Limits and Continuity. Partial derivatives of multivariate functions, Directional Derivative, Gradient, Divergence, Curl. Fundamental theory of vector fields. Lagrange multipliers and multivariate function extrema. Line integrals, multiple integrals (double and triple) and applications to physics and geometry: volume calculation, mass, torque, surface area. Surface integrals and applications in fluid flow. Green's theorem. Parametric representation of surfaces and applications. Stokes' theorem. The divergence theorem.	2	5
MATH 105	INTRODUCTION TO COMPUTER PROGRAMMING	Theory: Introduction to algorithms. Structured Programming. Development of correct and efficient algorithms. Main features of modern programming languages. Programming using Fortran and Python: Data input/output commands, use of data variables, arithmetic operations, iterations, control structures, vectors and matrices, use of data files, subroutines and functions. Assignments. Laboratories: Hands-on training on Fortran and Python programming in a Unix environment.	1	6
MATH 106	SCIENTIFIC PROGRAMMING	Theory: Introduction to the computing environment of Matlab software. Numerical Operations. Programming in the Matlab Software Environment - Introduction to Variables - Complex Numbers - Mfiles - Functions - Retrospective Functions - External Files - Tables - Polynomials - Graphs. Symbolic Variables and Operations - Derivatives - Integrals. Histograms - Three-dimensional Symbolic Diagrams - Solving Linear Systems in Matlab using the Symbolic Math Toolbox. Assignments. Laboratories: Laboratory exercises using computer systems in a Unix environment - Programming using Matlab software.	2	5
MATH 201	NUMERICAL LINEAR ALGEBRA	Introduction to Linear and Matrix Algebra. Direct methods for the solution of linear systems. Pivoting strategies, condition number, error analysis, determinants. Eigenvalues and eigenvectors. Diagonalisation. Iterative methods for sparse linear systems. Laboratory exercises using Matlab in Unix-like environment.	3	5
MATH 202	NUMERICAL METHODS	Solution of algebraic equations in one variable. Interpolation and polynomial approximation. Numerical differentiation and integration. Approximation theory. Initial and Boundary Value Problems for ordinary and partial differential equations. Laboratory exercises using Matlab in Unix-like environment.	4	6

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MATH 203	ORDINARY DIFFERENTIAL EQUATIONS	Introductory concepts, initial value problems. First- and second-order ordinary differential equations, separable, homogeneous, Bernoulli, Ricati, Euler, variation of parameters, exact equations and integrating factors. Applications in problems from mechanics. Linear independence and the Wronskian. Linear differential equations with constant coefficients. Laplace transform. Homogeneous and non-homogeneous equations with constant coefficients. Linear differential equations with variable coefficients. Power series solution method.	3	5
PHYS 101	PHYSICS I	Basic principles of kinematics and dynamics of a point and a solid body. Introductory elements of continuum mechanics for solids (stresses and strains) and fluids (stresses and rates of strain). The course is based on the knowledge that the new students have acquired at high school, while emphasis is set upon the application of the physical laws in 3D, vector presentation and using elements of differential and integral calculus to solve engineering problems. A main goal of the course is to introduce the former pupil to the engineering/scientific way of approaching problems. Based on classical physics exercises, the laboratory work aims to introduce the new students to the concepts of "experimental investigation" and data analysis: experimental design, experimental error, methods of data presentation, modelling the data with appropriate equations and parameter evaluation, making diagrams, using correct units and appropriate data analysis.	1	6
PHYS 102	PHYSICS II	Basic principles of electromagnetism; Laws of Ampere and Faraday; geometric and wave theory of light; interaction of electromagnetic waves and light with matter; techniques and technological applications. The course employs theoretical and laboratory exercises. Laboratory exercises: Oscilloscope; Resonance in a RCL circuit in series. Electron and hole movement in matter - Hall effect; voltage transformers; optical lenses; spectrograph-calculation of refractive index; interference - interferometer Michelsen, interference and polarisation of light; measuring electricity power; velocity of sound in liquids and air; Ohmic resistance; characteristic diode (p-n conductor); photodiode (light sensor) and light emitting diode (LED);Wheatstone bridge.	2	6
CHEM 101	GENERAL CHEMISTRY	Atomic structure and quantum mechanical approach; electronic configuration of the elements, Periodic Table; ionic and covalent bonds; molecular geometry and the VSEPR theory; Valence bond theory, hybridism, Molecular Orbital theory; metallic bond; intermolecular forces; chemical kinetics and equilibrium; solutions; acids, bases and salts; oxidation/reduction and electrochemistry. Laboratory exercises: Safety regulations of chemical labs; introduction and practice of basic laboratory techniques; making a solution of defined composition, measuring the concentration, solving problems. Types of chemical reactions; synthesis of PbCrO4, BaSO4 and Al(OH)3. Separation techniques. Chemical equilibrium, Le Chatelier principle. Chemical kinetics, rate defining parameters. Ionisation of electrolytes, indices, measuring pH by chromatography. Usage of atomic orbital and molecular models. Finding the stereochemistry of simple molecules. Dipolar moment and polarity of simple chemical compounds.	1	5

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CHEM 102	ANALYTICAL CHEMISTRY	Extraction; basic principles of chromatography, gas, liquid chromatography and HPLC; electromagnetic radiation and interaction with matter; spectroscopic analysis methods, instrumentation, AAS and AES, X-ray methods, Mass spectrometry; data analysis and reliability in chemical analysis. Laboratory exercises: Regulations of Analytical Chemistry Laboratory and basic instrumentation; measurement of pH of weak and strong electrolyte solutions, preparation of buffer solutions and comparison; titration analysis, neutralisation titration, blank estimation, equivalent point, complexation titration and water hardness; introduction to chromatographic techniques; cation separation by ion-exchange and strong acid management; techniques based on the interaction of electromagnetic radiation with matter; photometric analysis of solutions; X-ray fluorescence.	2	6
CHEM 201	PHYSICAL CHEMISTRY	The states and properties of matter. The Ideal gas and its PVT behavior and relationships. Kinetic theory. Diffusion of gases and liquids and calculations. PVT behavior of real gases: equations of states; the critical region; the virial and van der Waals equations; the law of corresponding states, etc. Chemical kinetics: rate constant and Arrhenius theory; reaction rate equations; experimental methods in kinetic data acquisition (batch, CST and PF reactors) and determination or reaction order; Reaction mechanism and rate equation; Kinetics and mechanisms of heterogeneous catalytic reactions (Eley-Rideal and Langmuir-Hinshelwood models); Applications for the design of chemical reactors. Thermodynamics: First law and applications; chemical thermodynamics; second law and applications; Enthalpy; Entropy; Gibbs and Helmholtz free energy; chemical potential; chemical equilibrium and calculations. Changes of states: Phases and Phases equilibrium; Liquid-vapor equilibrium and distillation; fractional distillation analysis and design; gas- liquid equilibrium and absorption; gas-solid surfaces equilibrium and adsorption; liquid-liquid equilibrium and extraction. Introduction to electrochemistry and fuel cells. Laboratory excercises: Absorption, Distillation, Chemical reaction kinetics, Extraction, Heterogeneous catalytic reactions.	3	5
MECH 102	ENGINEERING MECHANICS - STATICS	Rigid-body behaviour under the action of axial forces, torsional torques, bending torques and combinations under equilibrium conditions. Design and competency of structural elements. Basic principles of statics, material point (forces, vectors), rigid bodies; force synthesis and analysis; equilibria; analysis of isostatic networks; center of mass; geometrical stability. Types of load in constructions; beams and cables; definition of internal stresses; friction. Laboratory exercises: analysis of beams under concentrated load; study of networks using strain gauges; strains and stresses in a cross-section of a beam.	2	5

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MECH 201	STRENGTH OF MATERIALS	Internal forces, stresses. Strains. Stress-strain relationship. Statically indeterminate problems. Temperature effects. Shear deformation. Stress and strain distribution. Torsion. Pure bending. Asymmetric bending. Transverse loading. Transformation of stress and strain. Stresses under combined loading. Mohr circle. Stresses and deflections in beams. Energy methods. Laboratory exercises: experimental strength of materials; brittle tough failure; failure of metal in elongation; failure of concrete in compression; failure of metal in torsion; 3-point bending experiment.	3	5
MECH 303	MACHINE ELEMENT DESIGN	Materials and methods of construction; codes and standards.; approximate stress analysis; process of machine element design; joints; rivets; screws; welds; shafts; belts; spur gears; machine-element design using computational methods.	3	5
MECH 306	TECHNICAL THERMO-DYNAMICS	Types of energy; work and heat; thermodynamic properties of pure substances; 1st and 2nd Laws of Thermodynamics and their applications in closed and open systems; entropy; thermal power cycles; cooling cycles; Maxwell relations; thermodynamics of mixing; chemical potential; phase equilibria. Optional problem sets.	4	4
MECH 321	REINFORCED CONCRETE STRUCTURE ANALYSIS	Basic principles of structural analysis. Types of loads and supports. Stiffness and transformation matrices. Formulation and solution of equilibrium equations. Evaluation of member actions. Implementation of the direct stiffness method. Introduction to the finite element method. Basic theory of reinforced concrete structures analysis and design. Properties of concrete and reinforcement steel. Types of loads, limit states and related checks: compression, tension, bending moments, shear forces and moments. Design principles under Greek/Eurocodes norms. Computations for basic structural elements of reinforced concrete buildings. Code requirements and detailing provisions. Analytical and computational project	9	6
MRED 101	GEOLOGY	Physical phenomena and geosciences; Earth's structure (elements, minerals, rocks), structural elements of Earth's solid crust (magmatic or igneous rocks, sediments and sedimentary rocks, metamorphism and metamorphic rocks); tectonic plates theory; geological time scale, geological cycles; sedimentology and depositional environments; stratigraphy principles, stratigraphic correlations; introduction to tectonics, morphotectonics, microtectonics; geomorphology; environmental geology. Laboratory exercises: Geological processes sequence and stratigraphic principles; introduction to topographic maps, topographic sections of various scales; introduction to geological maps, drawing of simple geological sections, geological section with: superpositional layers of different thicknesses and calculation of the actual thickness of the layers, disconformity layers, faults, fault and vein intrusions, sections transverse to the strikes; calculation of surface appearance of separating plane from point measurement, strike calculation from drilling data.	1	5

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MRED 102	MINERALOGY (PRINCIPLES & METHODS)	Introduction to mineralogy; principles and methods. Crystallography; crystal chemistry; crystal structure. Crystal Growth elements of crystal chemistry and physical chemistry. Phase diagrams. Principles and methods of x-ray crystallography; strategies for mineral study by advanced techniques. Laboratory Exercises: Crystal symmetries; lattice geometry, lattice planes and Miller indices (hkl); evaluation of Debye-Scherrer diagrams and x-ray diffraction (XRD) patterns; design and evaluation of one- & two-components (binary) phase diagram.	1	5
MRED 201	SYSTEMATIC MINERALOGY	Physical characteristics of minerals, origin, mode of occurrence and association of minerals (native elements, sulfides and sulfosalts, halides, sulfates, carbonates, phosphates, oxides and hydroxides, silicates). Laboratory Exercises: Physical properties of minerals; macroscopic observation of minerals; identification of mineral chemical formula; Introduction to mineral identification by means of XRD, optical and e-microscopy methods.	2	4
MRED 202	PETROLOGY	Minerals and rocks; composition of Earth interior; rock forming minerals, igneous minerals; magma and its composition, magmatic crystallisation; magmatic differentiation; terminology and classification of igneous rocks; sedimentary rocks; clastic sediments (shales, marls, mudstones, sandstones, breccias, conglomerates), chemical and biogenic sediments (limestones, dolomites, evaporites, phosphorites, coals); metamorphic rocks, and their mineralogical components; metamorphic field relations; classification of metamorphic rocks; metamorphic fabrics; parameters controlling metamorphism. Laboratory exercises: 1. Rock forming minerals; 2. Microscopy; 3. Orthoscopic study using analyser; 4. Conoscopic study; 5. Granodiorite thin section study; 6. Ryolite thin section study; 7. Andesite and basalt thin section study; 8. Oivinite thin section study; 9. Macroscopic observation of sedimentary rocks; 10. Marble and gneiss thin section study; 11. Macroscopic study of plutonic, subvolcanic, volcanic, sedimentary and metamorphic rocks.	3	5
MRED 203	SEISMIC METHODS	Introduction to the seismic methods, 1D elastic wave propagation; body and surface waves, instrumentation, seismic refraction method, seismic reflection method, NMO, static corrections, velocity analysis; migration; application of seismic methods in mineral and hydrocarbon exploration, civil engineering, hydrogeology geotechnical and environmental problems.	5	5
MRED 204	APPLIED GEOPHYSICS	Introduction to applied geophysics, principles of the geophysical methods, gravimetry, magnetic methods, electromagnetic methods, instrumentation, data acquisition; applications in geothermy, hydrogeology, environmental problems, mineral and hydrocarbon exploration, archaeology and geotechnical problems.	4	5

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MRED 301	MINERAL EXPLORATION	PART A. Introduction to mining science. The history, the importance and the contribution of mining to civilization. Mining terminology, stages in the life of a mine, the economic value of mineral resources and their life cycle, surface and underground mining, environmental and safety issues. PART B. Mineral Exploration. Definition and terms, stages of mineral exploration and anticipated results. Drillhole sampling, data coding, recording and evaluation. Mineral resources reserve estimation and classification systems, sampling grids and number of required drillholes. Case studies of drillholes data evaluation and reserve estimation. Exercises: The course include computational exercises related to the design of sampling grids, evaluation of drillholes data, mineral resources reserve estimation using different methods (Thiesen polygons and triangles, sections), geostatistical methods, as well as the construction of isoparametric curves.	5	5
MRED 302	ORE PROCESSING	Liberation, sampling, optical-, gravity-, magnetic-, electrostatic-, heavy media-separation methods, flotation, leaching, waste disposal, valorisation of wastes. Laboratory practicals include: 1. Gravity separation – mass balance, 2. Flotation, 3. Spiral concentrator, 4. Shaking table, 5. Magnetic separation, 6. Electrostatic separation.	6	6
MRED 303	ENGINEERING GEOLOGY– SOIL MECHANICS	The geological materials. Soil description and classification. Soil water, permeability and flow. Shear strength of soils. Mohr Coulomb criterion. Elements of stress analysis. Soil compression and consolidation. The rate of foundation settlement. Bearing capacity. Soil compaction and ground improvement. Mechanical properties of rocks. Shear strength of discontinuities. Classification of rock mass. Stability analysis of natural and artificial slopes. Slope stabilisation methods. Engineering geological investigations for hydraulic structures. Tunnels and underground excavations. Tasks of engineering geological research. Laboratory work: Soil classification tests, oedometer test, direct shear test, unconfined compression, proctor test. Shear test on rock discontinuities. Tutorial Exercises: Rock mass strength by rock mass classification. Slope stability analysis.	6	5
MRED 304	GEOCHEMISTRY	Distribution of elements in Earth's crust; major and trace elements. Introduction to geochemistry of igneous, metamorphic and sedimentary rocks; introduction to geothermodynamics, diagenesis, analytical geochemistry, hydrogeochemistry. Applied geochemistry. Laboratory exercises: Introduction to analytical geochemistry. Solvation/sample preparation. Measuring pH and conductivity. Classical analytical methods. Gravimetric analysis. Volumetric analysis. Methods of instrumental analysis. Atomic absorption, atomic emission and x-ray fluoresence spectroscopy.	6	6
MRED 306	ORE DEPOSITS GEOLOGY	Terminology; magma and magmatic minerals; hydrothermal solutions; types of deposits; transport and deposition of metallic components, alteration zones; ores associated with plutonic and volcanic activity, ores in sedimentary rocks, metamorphic ores, hydrothermal ore deposits, supergene ores and supergene overprinting of ores - laterites, fossil fuels (coal deposits, oil, natural gas); assessment of ore deposits, research, economics and role of the Mineral Resources Engineer. Laboratory exercises: Ore microscopy; optical properties of ore minerals; microscopy study of various ore minerals.	6	5

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MRED 308	APPLIED FLUID MECHANICS	Theory: Physical and Rheological Properties of Fluids, Dimensions and conversions, Surface and body forces, Pressure and Shear Stress, Continuum Hypothesis, Control Volume, Hydrostatics, Buoyancy, Microscopic and Macroscopic Analysis of Flow, Newton's Law for viscosity, Stress Tensor, Newtonian and Non-Newtonian Fluids, Continuity Equation, Flow Equation, Equation of Mechanical Energy, Viscous and Inviscid Flow, Bernoulli Equation, Dimensional and Similarity Analysis, Laminar and Turbulent Flow, Reynolds Number, Flow Analysis in Pipes and Networks, Hydraulic Diameter, Fanning Friction Factor, Linear and Local Viscous Losses, Pumps, External Flows, Drag and Lift forces. Laboratory exercises: Measurement of viscosity of newtonian fluids. Shear stress vs shear rate diagrams for newtonian, Bingham, Herschel-Bulkley etc. fluids. Effect of Temperature on viscosity. Flow in annular conduit and flow rate vs. pressure drop. Hydraulic radius. Determination of flow type (laminar, transient of turbulent) and friction coefficient. Motion of solids within fluids and limiting velocity. Drag coefficient. Estimation of terminal velocity.	6	5
MRED 310	PROBABILITY & STATISTICS FOR ENGINEERS	Basic principles of probability theory, random variables, basic distribution functions, dependent random variables, correlation and dependence measures, multi-dimensional probability distributions, random variables functions; basic principles and methods of statistics, sampling functions, principles of estimation, statistical hypothesis testing, linear regression. Laboratory exercises (optional) in MatLab.	4	5
MRED 312	HYDROGEOLOGY & WATER MANAGEMENT PROJECTS	The hydrologic cycle. Groundwater Flow and Storage. Chemical hydrogeology. Aquifer types. Properties of aquifers. Principles of ground water flow. Ground water resources. Springs and analysis of springs discharge. Water wells and boreholes. Karst hydrogeology. Interface between salt and fresh water. The exploitation of coastal aquifers. Dewatering/ depressurization of underground workings and open pits. Laboratory work: Measurement of porosity and hydraulic conductivity of geological formations, hydro chemical analysis. Tutorial Exercises: Hydrologic budget for a drainage basin. Analysis of pumping tests. Hydro chemical data analysis and evaluation of groundwater quality.	5	5
MRED 314	PHYSICAL PROCESS ENGINEERING	Basic physical processes in production and exploitation of mineral resources. Experimental design. Basic laws used in physical processes. Mass and energy balances. Heat transfer, mechanisms and devices. Mass transfer, phase equilibria, distillation, extraction, adsorption, absorption, drying.	6	4
MRED 316	COMPUTER AIDED DRAFTING	A) Introduction to electronic imaging. Operating systems and methods. Classical and electronic drawing. Drawing information organisation. Possibilities and applications. Basic principles. B) Introduction to AutoCAD. Basic commands for 2D drawing and processing. Preparation. Organisation in levels. Blocks. Drawing units. Hatch. Dimensioning. Text and editing. Complex drawing commands. External references. Printing. C) Introduction to 3D and photorealism, commands. D) Parametric drawing. Drawing mechanical parts. Simple architectural drawing, topographic, floor plan, section, face.	6	3

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MRED 318	GEOLOGY & ORE GEOLOGY OF GREECE	Actualistic model of the geotectonic development of the oceans realm, main stages of the evolution of the Alpine cycle, Rhodope Massif, Serbomacedonian Massif, Circum Rhodope zone, Axios zone, Pelagonian zone, Attico – Cycladic zone, Subpelagonian zone (Eastern Greek zone or non metamorphic Pelagonian zone), Boeotian zone, Parnassos - Gkiona zone, Olonos-Pindos zone, Tecto-orogenetic evolution, Gavrovo - Tripolitsa zone, Ionian or Adriatic zone, the metamorphic system of the external Hellenides, the Plattenkalk Group, the Trypali unit, Phyllite-Quartzite series, post-alpine sediments and formations, Molassic sediments, Neogene and Quaternary formations, Tertiary and Quaternary volcanism in Greece.	8	
MRED 401	METALLURGICAL PROCESSES FOR METAL & CERAMICS PRODUCTION	Mass and energy balance, basic metallurgical processes, reactor design, best metallurgical practices in pyrometallurgy and hydrometallurgy, waste minimisation. Ceramic materials, structure and properties, sintering, phase diagrams, processing and applications of traditional and advanced ceramics, uses of ceramics in metallurgy. Laboratory practicals include: 1. Slip casting, 2. Mixing -extrusion, 3. Isostatic pressing, 4. Sintering – shrinkage determination, 5. Hg porosimetry, 6. Dilatometry, 7. Open porosity, density and water absorption, 8. Bending strength	9	6
MRED 402	ROCK MECHANICS	Stress-strain theory in continuum rock media, constitutive equations, theories of failure, effect of time on strength, excavation and stability of openings, rock classification systems, support of underground works, special issues. Laboratory exercises: stress-strain calculations, stress invariants, elasticity, plasticity, failure criteria, stress-strain calculations in underground and surface works, wedge and slope stability, sleeve bolts, pole strength, experimental measurements of elasticity, plasticity and strength in uniaxial and triaxial compression, strength in intermediate elongation (Brasil test).	8	6
MRED 403	DRILLING - BLASTING & BORING OF UNDERGROUND CONSTRUCTIONS	Explosives, drilling, design of surface and underground explosions; storing and destroying explosives; special issues; introduction to underground exploitation and works. Exercises: pneumatic hammers (high pressure air network)l; open-air, delays, underground, special explosions; rock fragmentation, vibrations and air overpressure.	7	6

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MRED 404	HEALTH AND SAFETY IN MINING & UNDERGROUND CONSTRUCTIONS	History and importance of occupational health and safety, basic concepts and definitions, main causes-categories of occupational accidents, statistical indicators and theories of accidents. Occupational hygiene hazards: dust, chemicals, noise, vibration, microclimatic environment, lighting, radiation. Occupational safety hazards: mechanical equipment, electricity, materials handling, excavations, explosives. Mining hazards according to USBM. Methods of identifying hazards and assessing occupational risk. Health and safety legislation, Regulation for Mining and Quarrying Works. Presentation of relevant issues from surface and underground mines and construction sites. Laboratory exercises: There are 4 laboratory exercises related to the measurement of various harmful factors, an accident analysis and a final oral examination. The exercises are: Exercise 1: Measurement of dust concentration in the working environment with direct and analytical (gravimetric) method. Exercise 2: Measurement of noise and mechanical vibrations at work. Exercise 3: Measurement of harmful gases, parameters and indicators of microclimatic environment, electromagnetic radiation, light intensity. Exercise 4: Simulation of sampling of gases and liquids using IHVL software. Exercise 5. Accident analysis with the event tree method.	8	5
MRED 405	ENGINEERING GEODESY	Definition and classification of geodesy, historic development, earth and its motions, precession, nutation and polar motion, gravity field of the earth, gravity potential, spherical harmonics, actual shape of the earth, geoid, biaxial ellipsoid, time, methods for determining and disseminating time, applications to geophysics, maps, mercatoric, Lambert, Greek Geodetic reference systems, instruments, methods of positioning, applications to geophysics, mining, environmental monitoring, geodynamics etc. Three field trips and two laboratory exercises: Determination of tunnel axis; study of tunnel construction; geometric level; determination of coordinates of an inaccessible point; calculation of excavation in technical works; charts and General Mapping Tools (GMT) software.	7	6
MRED 406	SURFACE MINING	Terminology, basic elements of exploration, designing and scheduling of open pit exploitation; exploitation of decorative stones (mining with drilling, diamond wire cutting, chain saw, mild explosions and combinations); theory of mechanical drilling and cutting of rocks, selection of equipment (rotational or/and impact), compressed air networks; non-continuous mining and transport; mechanics of open pit exploitation, techno-economic analysis of technical works, yield of mechanical shovels. Laboratory exercises: study of open-pit exploitation or marble quarry.	8	5

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MRED 407	RESERVOIR ENGINEERING I	Theory: Introduction to Petroleum Engineering, physical and chemical properties of hydrocarbon (HC) mixtures, Gibbs phase law, phase equilibria of a pure substance, binary and multiple systems; phase windows; properties and constitutive equations of gases, volumetric coefficient of gas phase; properties and constitutive equations of liquids, volumetric coefficient of liquid phase; properties of biphasic systems, total volumetric coefficient of transformation; phase equilibria, equilibrium coefficients; sampling methods for liquid reservoirs (LR), properties of LR; oil, gas condensates, surface separations of HCl; transformations of PVT data, Petroleum Engineering correlations. Laboratory exercises: program PVTlab; phase equilibrium (P-T) diagram of oil; boiling point and compressibility coefficient of HC mixture; volumetric oil production coefficient (Bo) and gas to liquid ratio (GOR), chromatographic analysis of produced HC gases and liquids and calculation of the composition of the oil in the reservoir; WinProp simulator.	7	6
MRED 410	INDUSTRIAL ECOLOGY	Principles of sustainable development, strategic raw materials, energy and raw material savings in basic industrial processes, minimisation of process environmental footprint, risk assessment, soil and water remediation methods, introduction to life cycle analysis. Laboratory practicals include: 1. Limestone crushing in jaw and cone crushers, 2. Limestone grinding in rod mill– grain size analysis, 3. Hydro- and air-separation, 4. Pulp thickening, 5. Prediction of acid mine drainage potential of wastes, 6. Toxicity determination of wastes (TCLP test).	5	5
MRED 411	MATERIAL SCIENCE	The concept of “material”; atomic structure and bonds; crystalline and amorphous structure; mechanical properties; defects and reinforcing mechanisms; failure and ultimate properties; phase diagrams of metals and microstructure development; metal alloys; structure, properties and processing of ceramics; structure properties and processing of polymers; composites; material selection for the design and manufacturing of products. The course uitilises knowledge of MECH-201, Strength of Materials and MRED 102, Mineralogy.	7	5
MRED 412	COAL BENEFICIATION	Theoretical lectures: Role of solid fuels in the global energy market, Origin and classification of coal, Physical and chemical properties, Pretreatment, Beneficiation, Briquetting Process, Carbonization, Liquefaction, Gasification. Laboratory Exercises: Coal beneficiation using the heavy liquid separation method; proximate analysis of coal; characteristic parameters of coal pyrolysis and combustion; kinetic analysis of thermogravimetric data from coal pyrolysis; determination of fluid flow pressure drop through a fixed bed of solid particles; determination of minimum fluidisation velocity of a solid particles bed.	8	5

Code	Title	Description	sem.	ECTS
MRED 413	COMPUTER AIDED MINE PLANNING	Part A. Advancement and contribution of computers to mineral industry. Mine planning phases. Drillhole data recording, processing and calculation of composite samples. Statistical and spatial analysis of composite samples and development of digital models of the studied deposit by using the inverse distance weighting and the Kriging methods. Pit design and estimation of ultimate pit limits by using blocks economic values (Moving cone and Lerch-Grossman algorithms). Part B. Continuous surface mining methods. Design of surface mining operations with special emphasis on lignite mines. Method selection criteria, description and performance calculation of continuous operation equipment (bucket-wheel excavator, conveyor belts, stackers). Criteria of rock diggability with a bucket-wheel excavator. Production scheduling. Exercises: The teaching of the course includes 5 assignments and an examination: 1. Registration and processing of mining exploration drilling data (Topographic, thematic maps, drilling data, geological information). 2. Calculation, statistical and spatial analysis of composite samples. 3. Development of deposit digital model using local estimation methods and reserves and grade estimation. 4. Economic model of the deposit and determination of the optimal pit limits. 5. Pit design, production planning and calculation of the net present value of the resulting cash flows.	7	5
MRED 414	RESERVOIR ENGINEERING II	Theory: Formation of Hydrocarbon (HC) reservoirs, properties of porous medium, permeability, Darcy's law for flow in porous media, flow on reclining porous media, methods of core sampling in underground reservoirs, alterations induced by the sampling; measurements, flow systems in reservoirs; flow of incompressible, partially compressible and compressible fluids, time dependence, flow in layers in series and in parallel, radial flows, Darcy's law (differential form - diffusion equation) in linear and radial flow for (partially) compressible fluids; efficiency index of the bore hole, flushing of the porous medium with water, interfacial tension between fluids, capillary pressures, wettability of the medium, relative permeabilities, distribution of the fluids in HC zones, analysis of pressure measurements in underground reservoirs. Laboratory exercises: Measurements of: active porosity; permeability; remaining saturated water; Hg porosimetry.	8	5
MRED 415	FOSSIL FUELS	Raw materials for energy production, deposits, environmental impact; Origin of fossil fuels; Natural gas, properties, production, processing; Oil, properties, distillation, petroleum products; Non-conventional fossil fuels, tar sands, shales, hydrates, properties, production, processing; exploitation; Instrumental analysis, gas and liquid chromatography, spectroscopy, applications for fossil fuels; Environmental effects of fossil fuel production and use; Methods for oil pollutants characterisation and rehabilitation. Laboratory exercises: Measurement of physical properties of oil and petroleum products (density, refraction index, cold properties, viscosity); Distillation (ASTM D-86 and SimDist); Measurement of asphaltenes in oil samples; Measurement of petroleum HC in soil sample.	7	5

Code	Title	Description	sem.	ECTS
MRED 416	REMOTE SENSING	Basic principles, earth surveying systems, photographic nad detection systems; multispectral digital satellite images and spectral analysis, LANDSAT, SPOT, MOS, Ikonos, QuickBird, ASTER etc. images, thermal images, RADAR, independent and biased classification, introduction to photogrammetric capture, satellite image processing; applications in detecting and pointing down minerals etc; unmanned imaging systems. Laboratory (computer based) exercises: electromagnetic radiation (separation ability, paths, solar constant, spectral initiation ability); earth usage and aerophotography; stereoscopic vision; SPOT and Landsat satellites; remote sensing satellite orbits and images; educational image analysis software BILKO; infrared images; Radar images, distinction ability, Rayleigh coefficients.	8	5
MRED 417	INDUSTRIAL MINERALS & ROCKS	Terminology, description of industrial minerals and rocks, classification of industrial minerals and rocks, geological characteristics, position, research and applications; properties, physical, chemical and technological characteristics, assessment criteria for diverse applications. Industrial minerals deposits in Greece; macroscopic characteristics; polarizing microscopy. Field trips and laboratory exercises: optical microscopy and assessment of industrial minerals and rocks.	7	6
MRED 418	GEOTECHNICAL ENGINEERING & TUNNELLING	Linear elastic geostatic stresses and torques, elastic settlement (foundations); Winkler theory of elastic bearing, compressibility and consolidation of soils; strength and failure mechanism of non-cohesive soils, friction and dilatation, theory of Taylor; applications: critical depth of unsupported tunnel, estimation of roof support, dilatation theory in 3D, critical condition theory; behaviour of undrained particulate mater - fluidisation; theory of cohesive soils and rocks: failure theories of Griffith, Mohr Coulomb, Tresca, Drucker-Prager; Dilatation of rocks, discontinuities; analysis of geotechnical structures: Coulomb theory, retaining structures, load bearing capacity of surface foundations, slope stability, underground chamber support, load bearing capacity of poles; tunnel construction: geotechnical-geostatistical model of heterogeneous geological formations, numerical methods for stress-strain analysis around underground openings, tunnel construction methods, design via the stress convergence-discharge method, TBM, Roadheader devices, settlement over shallow tunnels, deep tunnels, failures in underground excavations.	8	5
MRED 422	INSTRUMENTAL METHODS IN MINERALOGY & PETROLOGY	The characterization of minerals, rocks, ores and various geological materials can be implemented by a “state-of-the-art” combination of diffraction, microscopic and spectroscopic methods. Within the frame of this course the student learns the basic principles and methodology and how to process and evaluate data regarding XRD in bulk and microscale, optical microscopes, electron microscopes (SEM-EPMA, TEM), Synchrotron-based X-ray spectroscopies in bulk and microscale (micro-XANES/-EXAFS) using appropriate software packages..	8	5

Code	Title	Description	sem.	ECTS
MRED 424	QUALITY CONTROL AND EQUIPMENT RELIABILITY	Part A. Quality control. Historical development and general concepts of quality control (assurance, certification, ISO, total quality). Statistics and probability theory for quality control. Sampling for variables and quality characteristics. Methods for determining single, double, multiple and continuous sampling plans. Statistical process control, construction of control charts x-R, x-S, cumulative, moving average and acceptance. Hotelling control charts for multiple quality characteristics. Examples and applications from the mineral industry (mining companies, cement companies, etc.). Part B. Equipment reliability. Basic concepts, definitions and mathematics for equipment reliability. Reliability models (systems in series, in parallel, in mixed configuration, systems with redundancy). Calculation of reliability of continuous and discontinuous mining systems. Exercises. The teaching of the course includes 7 laboratorial and computational exercises: 1. Characterisation of concrete strength by Schmidt hammer and statistical analysis of measurements-errors. 2. Computer simulation of simple and continuous sampling plans. 3. Calculation of basic statistical quantities required during quality control sampling, confidence intervals and sample size. 4. Design-analysis of sampling plans. 5. Statistical control process diagrams (SPC) for quality variables as well as for quality characteristics. 6. Calculation of reliability of mining equipment. 7. Calculation of reliability of continuous mining systems.	8	5
MRED 426	ORGANIC GEOCHEMISTRY	Origin of organic fossil fuels; the carbon cycle; creation and composition of biomass; organic mass in sediments; theories for the origin of petroleum; biogenesis, abiogenesis, transgenesis, katagenesis, metagenesis; maternal petroleum rocks; migration, reservoir creation; bio-indices; methodology of organic geochemistry research. environmental applications. Laboratory exercises: Grinding, sieving and drying samples of maternal rock of reservoirs; RockEval determination of composition and maturity of organic matter in sediments; Soxhlet extraction; deasphalting and column chromatography; gas phase chromatography - Mass spectroscopy of the saturated fraction to determine bio-indices and maturity.	8	5
MRED 428	TECHNOLOGY OF NON METALLIC MATERIALS	Advanced course in Non-metallic materials: Characteristics, microstructure properties viscoelasticity and processing of polymers; structure, properties and firing of ceramics, classic and advanced ceramics; Definition and types of composites, property estimation, nanocomposites, special composites. Continuation of the course ΜΟΠ 411, “Material Science” (7th semester). It uses knowledge of the course ΜΟΠ 201 “Strength of Materials”.	8	5

Code	Title	Description	sem.	ECTS
MRED 501	ENVIRONMENTAL REMOTE SENSING	Interaction of satellite remote sensing with the environment; the role of remote sensing, information sources and systems; improving spectral and geometrical image elements, filters, indices, transformations, classification, image analysis and neural networks; contemporary sensor systems from aircraft and satellites, future trends of remote sensing in research; unmanned systems, design, parametrisation, programming, navigation, real time analysis, flight analysis; 3D surface models, DEMs, unmanned aircrafts, multispectral data, virtual reality, visualisation; positioning services in mobile devices, space research in Earth Observation; machine learning (CNN). Exercises: Geometry of satellite images, transformations, corrections; radiometric corrections; Improvement of the histogram; filters; edge enhancement; application of Fourier transform in digital images; coordinate transformation; supervised/unsupervised classification of satellite images; use of unmanned vehicles for topographic 3D imaging; photogrammetry; mobile applications.	9	6
MRED 503	GEOTHERMICS	Exploration - exploitation of geothermal fields, characteristics of the Greek geothermal fields; low, mid and high enthalpy fields; stages of geothermal research, geothermal exploration and exploitation techniques, characteristics of Greek, European and other geothermal fields; geothermal fluids; geothermometers; technical and environmental issues; secondary minerals formation and scaling in geothermal exploitations; urban heating and cooling using geothermal heat pumps. Laboratory exercises: Stages of Geothermal research and development of techniques for the detection and exploitation of geothermal fluids. Instruments and apparatus for temperature, geothermal gradient, thermal conductivity and thermal flow measurements. Problems occurring in the piping networks of geothermal fluids. Physicochemical characteristics and chemical analysis of geothermal fluids. Water-rock interaction. Water ion origin. Physicochemical processes. Quality parameters (pH, TDS, conductivity, hardness, alkalinity, salinity) and hydrochemical plots (Piper, Schoeller, Giggenbach triangle). Interpretation of geochemical data-ion ratios. Water thermodynamics. Activity, activity coefficient. Solubility Product vs. Temperature, saturation indexes. Chemical geothermometry. High enthalpy waters characteristics. Software (Aquachem-Waterloo hydrogeologic, Phreeqc-USGS)	9	6
MRED 505	UNDER-GROUND MINING METHODS	Terminology of mining methods, description of types of exploitation faces, mining methods classification, open stopping, cut-fill stopping, caving stopping, CAD of mining methods, ventilation principles, hoisting systems, history of tunneling, tunnel design, tunnel construction (NATM, TBM etc.), tunnel support, soft ground engineering, numerical analysis of tunnel and underground excavations stability Laboratory exercise: basic study for an underground exploitation.	9	6
MRED 507	WELL LOGGING	Historical development of well logging methods, basic principles of well logging techniques, data acquisition and interpretation, electric logs, natural radioactivity logs, gamma rays, self potential logs, density logs, neutron logs, sonic logs, electromagnetic wave propagation logs.	9	6

Code	Title	Description	sem.	ECTS
MRED 509	DRILLING ENGINEERING	Formation and basic characteristics of H/C Reservoirs, Basic Exploration Strategies, Onshore and Offshore Drilling Equipment, Drill string, drill bits, casing design and operations, cements and cementing operations, properties and rheology of drilling fluids, drilling hydraulics, Formation pressures and calculations, Directional and horizontal drilling, Completion procedures, Kicks and Blowouts, Safety Issues.	9	5
MRED 511	APPLIED GEOSTATISTICS	Basic principles of spatial analysis, random fields, basic functions of spatial dependence (auto-covariance, cross-covariance, auto-correlation, variogram), concepts of stationarity, ergodicity and anisotropy, dependent random variables, multivariate models, introduction to simulation, variogram estimation from scattered spatial data, spatial estimation using Voronoi polygons, spatial interpolation (optimal estimation) using stochastic (kriging) methods, uncertainty evaluation.	7	5
MRED 513	AGGREGATE & BUILDING MATERIALS	Characterisation and type of aggregates, construction and building materials; technical works and structural elements; properties and selection of construction materials; requirements, standards, regulations; forms, properties and uses of natural stones; natural and synthetic aggregates, properties, requirements and standards; types and properties of powders and mortars, raw materials, production, usage, quality control; types and properties of concrete, raw materials, compositions, quality control. Laboratory exercises: petrographic rock analysis; particle size distribution and composition of aggregates; determination of fines in sand; toughness, strength, wear, of aggregates; production of lime; slaking rate method.	9	6
MRED 517	SOLID FUELS EXPLOITATION TECHNOLOGIES	Energy consumption, reserves, environmental issues, policy, Combustion of conventional and renewable fuels (effect of feedstocks, small-scale and large scale systems, co-combustion, emissions control technologies), gasification of conventional and renewable fuels (effect of feedstocks, processes, gasification systems, flue gas upgrading), environmental impacts from solid fuels utilisation-control methods (cleaning technologies for solid and gaseous emissions, control technologies for gaseous, liquid and solid wastes). Laboratory exercises.	9	6
MRED 521	FRACTURE MECHANICS	Fundamentals of Fracture Mechanics, Historical Notes, Stresses and Strains in a Continuum, Crack Modes, Mathematical Analysis of Cracks, Experimental Fracture Mechanics, Applications in Rock Engineering and in Seismology. Laboratory exercises: force balance in cartesian and polar coordinate systems; stress in thick-walled pipe and around a round hole; stresses at the edge of a crack.	9	6
MRED 523	MINERAL PROCESSING PLANT DESIGN	Design of beneficiation plants using the MODSIM simulation program. Usage, graphics, data input in the plant flow streams. Examples and parameters of process models and subroutine development for the models. Results of the program. Coal beneficiation plants. Special issues.	??	

Code	Title	Description	sem.	ECTS
MRED 527	ENVIRONMENTAL GEOCHEMISTRY	Review of basic principles, thermodynamics, kinetics and equilibrium. Carbon dioxide-Carbonic acid-Carbonate system, natural waters pH. Oxidation -reduction reactions, Eh-pH diagrams, stability of water. Adsorption desorption processes, isotherms, complex formation. Types of pollutants, anthropogenic impact, heavy metals, asbestos minerals, silica, carbon dioxide, acid mine drainage, acid rain. Clay minerals, zeolites, organic matter. Box models geochemical cycles, speciation, water chemistry models. Case studies.	9	6
MRED 530	GEOGRAPHIC INFORMATION SYSTEMS	Processing, enhancement, analysis, visualisation and information extraction from data from the geographical space. Coordinate systems, chartography, representation of spatial data; tools and methods of spatial analysis, geographical databases, vector and raster representation, generalisation, interpolation and management of spatial data in 3D space; network analysis, application of artificial intelligence, analysis of point cloud, positioning services and Web-GIS. The course also aims at the development of the perception of the research aspects of the GIScience and the use of specialized tools and open source software.	5	5
MRED 702	FIELD TRIP I	Three one-day field trips. Orientation in the field, usage of topographic - geologic maps and compass; identification in the field and interpretation of simple geological concepts: layers, strikes and dip direction of rocks; differences between metamorphic and non metamorphic sedimentary rocks; litho- and bio-phases; in situ interpretation of basic geological map elements (lithological, stratigraphical units and contacts), measurement of folds, microfaults, fissures, cleavages (geometry, interpretation and origin models) in metamorphic rocks of different lithology (marble, quartz, schists).	4	3
MRED 704	FIELD TRIP II	1-day field trip and four lectures on subjects of applied mineralogy-petrology (on the island of Crete) with emphasis on the characterisation of mineral resources from Greece and Europe.	5	2
MRED 706	FIELD TRIP III	5-day field trip on subjects of economic and applied geology, mine exploitation and beneficiation outside Crete; 7-day field trip in Crete on subjects of applied geophysics; and 3-day field trip on these subjects in areas of the greek mainland.	6	3
MRED 708	FIELD TRIP IV	This course involves a five (5) day geophysical field school in Crete. Geophysical methods including geological mapping, are applied on actual problems (e.g. saltwater intrusion at coastal areas, biogas containing formations). The students gain experience in geophysical data acquisition and processing using methods such as: seismic refraction, VLF, electrical tomography, electrical sounding and slingram electromagnetic.	8	3

Code	Title	Description	sem.	ECTS
MRED 709	SUMMER PRACTICAL TRAINING / INTERNSHIP	The summer practical training is an integral part of the educational process and is implemented, during the period April - October, in a company or institution related to mineral resources engineering topics with a duration of at least 1 month. The objective of the internship is to connect education with the professional environment that the students will meet in the labor market after graduation. Priority is given to students who have completed the 8th semester (or higher) while vacancies can be filled by students who have completed the 6th semester. According to the Faculty Meeting 8/16-5-2018 decision, students can participate in the Summer Practical Training / Internship only if (i) they have completed the 8th semester and have passing grades for at least 20 courses, 6 of which are compulsory in the third and fourth years, (ii) they have completed the 6th semester and have passing grades for at least 15 courses, three of which are compulsory in the third year of their studies. More information can be found in the website https://www.tuc.gr/index.php?id=1853.	9	6
MRED 800	GEOTECHNICAL SITE INVESTIGATION AND FIELD TESTS	Planning of geotechnical investigation; use of geological and geotechnical map; borehole layout and spacing; sampling and laboratory tests. In situ testing; assessment of field permeability (Lugeon, Maag, Lefranc tests); strength and deformation tests (standard penetration test, cone penetration and piezocone penetration tests, vane test, plate load test, pressuremeter tests); selection of in situ test method. Instrumentation of movements, deformations and stresses; extensometers, inclinometers, settlement gauges, pressure cells, standpipes and piezometers; interpretation of measurements and presentation of results. Selected case studies.	8	5
MPD 102	OPERATIONS RESEARCH	Methodological framework of operations research. Introduction to graph theory with applications to project management. Inventory control. Wilson's model and extensions. Introduction to linear programming. Multiple-criteria decision making, Case studies.	3	5
MPD 121	ELECTRIC CIRCUITS	Electrical quantities: charge, current, potential, energy, power. Elements of electric networks: resistor, inductor, capacitor, dependent and independent sources, switches. Electric network theorems: Kirchhoff's laws, voltage and current division, combination of resistors in series and parallel, principle of superposition, combination of inductors in series and parallel, combination of capacitors in series and in parallel, Kennelly's theorem, source transformations, Thévenin's and Norton's theorems, Millman theorem, symmetric circuits, nodal and loop methods. Elementary transient phenomena. Sinusoidal steady-state analysis of electric circuits: phasors, impedance, power, network theorems. Three-phase circuits: delta and star connection of three-phase windings, power, power factor correction, transformers. Laboratory: Simulation of electric circuits using the SPICE software	4	5
MPD 222	SYSTEMS MANAGEMENT FOR ENGINEERS	Introduction to systems thinking. Management processes: planning, organising, directing and controlling. Team management. Principles of management problem solving. Discussion of case studies.	6	4

Code	Title	Description	sem.	ECTS
MPD 422	INVESTMENT DECISION ANALYSIS	Financial Mathematics. Time value of money. Capitalisation. Annuities. Investment decision under certainty. Overview of the investment evaluation criteria. Investment decision under uncertainty. Uncertainty and risk. Investment decision under indefinite future. Investment decision under probabilities. Risk and Return of a portfolio. Portfolio selection and management; market model, capital asset pricing model. Case studies. Laboratory: The laboratory courses serve educational needs and activities related to the course of Investment Decision Analysis. The laboratory courses deal with case studies concerning the financial mathematics, investment decision under uncertainty, investment decision under indefinite future and portfolio selection. For the settlement of the exercises and the case studies, spreadsheet software program excel is applied.	6	4
MPD 433	SMALL-MEDIUM ENTERPRISES & INNOVATION	Establishment and operation of Small and Medium Enterprises (SME). Classification of SMEs. Organisation and management of SMEs. Management accounting. Corporate and tax legislation for SMEs. Cost accounting for SMEs. Financing of SMEs. Financial investment, analysis. Preparation of business plans. Project and resource management. SME development models. SME sustainability. Leadership. Innovation and SMEs. Innovative ideas. Creativity, Marketing. Marketing Plan. Competition, Market Segmentation. New product design and development, Sales Promotion, SMEs' evaluation, Strategy Development and Evaluation. Laboratory: Use of special software platform for business games and development of marketing plans through market simulation.	8	5