



Course Description

B.Sc. Program in

Environmental and Applied Geology

0305100 Environment**(3 Credit Hours)****Prerequisite: (None)**

This course aims at introducing the student to the rudiments of environmental science whose corner stone was laid in the second half of the 20th century. This is being accomplished by discussing the following topics: The earth and natural hazards; Ecosystems; Biogeochemical Cycles; Man and the Environment and the Natural Resources in the Solid Earth System; Air Pollution; Water Resources, management and Pollution; Solid Waste; Food and Health; Environmental Impact Assessment.

0305101 General Geology**(3 Credit Hours)****Prerequisite: (None)**

This Course provides a base of general earth science knowledge, which would help the student, better understand the natural world of which we are an inseparable part. This course includes four major units as follows: Earth materials: Earth and the universe; Minerals; Rocks (Igneous, Sedimentary, and metamorphic); Processes that shape the earth surface: Weathering and Soils; Mass wasting; Surface and ground water; Volcanic Activity; Wind and Deserts; The Evolving Earth: Rock Deformation; Earthquakes; Plate Tectonics; Geologic Time scale; Fluid spheres: Oceans; Atmosphere.

0305102 Principles of Environmental Geology**(3 Credit Hours)****Prerequisite: (0305101)**

Earth: systems and cycles; hazardous geologic processes: earthquakes, volcanic eruptions, tsunamis, landslides, sinkholes, floods; hazards of ocean and weather; meteorite impacts; fossil fuels; energy alternatives; mineral resources and the impact of their mining on the environment; soil resources; water resources; human impacts on the environment: waste disposal, contaminants



in the geologic environment; atmospheric change and global warming.

0305111 General Geology Lab. (1 Credit Hour)
Prerequisite: (0305102)

Eight laboratory sessions emphasize: identification of minerals and rocks, their properties, classification and origin. Calculation of residence time of rock in the continental crust, Sedimentary rocks and Mantle. Earthquake magnitude, Soil carrying capacity. Six laboratory sessions emphasize: soil, water and, air pollution problems; one day field trip is a requirement.

0305201 Stratigraphy and Historical Geology (4 Credit Hours)
Prerequisite: (0305101)

Evolution of stratigraphic classifications; present day classifications; types of lithostratigraphic units; combined successions of strata; sequences: surface outcrops, correlation of strata, unconformities; chronostratigraphic units; Eras and their characteristics: divisions, sediments, fossils; stratigraphy as a tool in: mineral, water, and petroleum exploration; three hours lab each week and three days field trip are required.

0305 202 Geodesy and surveying (3 Credit Hours)
Prerequisite (0305101)

Introduction, Shape of the Earth, Subdivisions of Geodesy, Classical, dynamic, Spatial, Earth Datum , Topographic surface, Physical surface - The Geoid, Mathematical Surface - The Ellipsoid, deviation of the Vertical, The coordinates, elements of Triangulation & Trilateration, Concept of Altitude, modern positioning systems, Inertial positioning system IPS, Satellites and Global positioning system GPS, Geodetic Networks, The National Jordanian Geodetic Network, Elevation determination, DTM, use of Radar interferometry, Applications of geodesy and surveying, geological, geophysical, tectonic applications, Case studies, dams monitoring, deformations, subsidence and sinkholes related to the Dead Sea lowering, Elements of Map Projections, Cylindrical, Azimuthal, Conical projections, essential map proprieties.



0305203 Meteorology

(3 Credit Hours)

Prerequisite (None)

The course studies the basics of meteorology: climate and weather, composition and evolution of the atmosphere, structure of the atmosphere, sun radiation and its budget on Earth, temperature and pressure: measurement and distribution on Earth, temperature and pressure maps for a selected area, factors affecting the changes in pressure and temperature, water vapor: measurement, cloud formation and types of precipitation. Winds: terminology, speed measurement and the relation between wind speed and pressure maps. Air masses and air fronts. Drawing, reading and interpretation of weather maps. Certain problems in the atmosphere: global warming, Tornados, hurricanes, El Nino, La Nina, paleoclimate and future climate of our part of the world.

0305211 Optical Mineralogy Lab

(1 Credit Hour)

Prerequisite (0305221 or simultaneous)

This lab introduces the student into the techniques of identifying rock-forming minerals using the polarized microscope. This achieved through the measurement of a set of optical properties of minerals; these include: form, color, pleochroism, interference colors, types of extinction, interference figures: uniaxial and biaxial minerals and the $2V$ angle. The theoretical basis for these properties will be given as introductions to the labs. The lab will be given for whole semester three hours weekly.

0305212 Petrology Lab

(1 Credit Hour)

Prerequisite (0305231 or simultaneous)

This lab deals with the identification of the three rock types: igneous, sedimentary, and metamorphic through systematic description of hand specimens and optical properties of minerals and their types and quantities. This course will also cover the principles of systematic rock classification through their mineral composition and textures. All this will be used to understand their petrogenesis. The lab will be given for the whole semester three hours weekly.



0305221 Mineralogy (3 Credit Hours)

Prerequisite: (0305111 or simultaneous)

Crystals and crystallization; crystal and mineral chemistry; physical and optical properties of minerals; X-ray crystallography; mineral groups: native elements, sulphides, sulphosalts, oxides, hydroxides, halides, carbonates, nitrates, borates, sulphates, chromates, tungstates, phosphates; silicates: orthosilicates, chain silicates, sheetsilicates, and framework silicates.

0305231 Petrology (3 Credit Hours)

Prerequisite: (0305221)

Igneous rocks: structures, textures, chemistry, magmas, mineralogy and classification; sedimentary rocks: textures, structures, sedimentary processes; classification and description of the main sedimentary rocks; metamorphic rocks: textural and structural aspects, mineral assemblages, metamorphic conditions; a three days field trip to south Jordan are required.

0305271 Fundamentals of Geophysics (3 Credit Hours)

Prerequisite: (None)

Fundamental concepts of coordinates; the Earth's gravitational field and gravimetric prospecting; the Earth's magnetic field and magnetic method; electrical methods; role of electrical resistivity and potential methods in exploration; elements of radioactivity methods; geothermal energy; seismic methods: refraction, reflection; integrated geophysical methods.

0305301 Invertebrate Paleontology (3 Credit Hours)

Prerequisite: (0305201)

Introduction; fossils: preservation, occurrence, use as indices of environment, their biology and history; Mollusca: Pelecypoda, Gastropoda, Cephalopoda; Echinodermata; Crinoid; Brachiopoda; Coelenterata; Arthropoda; Graptolithina; Porifera ;Bryozoa; microfossils: Foraminifera, Radiolaria, Ostracoda ; plant fossils; a three days field trip to Aqaba and three hours lab each week are required.



0305302 Basics of Astronomy

(3 Credit.Hours)

Prerequisite: (None)

The importance of astronomy; history of astronomy and developments celestial object and how to measure the distances and sizes, telescopes; the solar system and the planetary geology; stars: types, properties and evolution, light spectrum, dead stars, galaxies: types and evolution; cosmology and the origin of the Universe.

0305311 Field Techniques

(3 Credit Hours)

Prerequisite: (0305111)

Familiarization with compass and topographic maps and other field equipment; stratigraphic cross and columnar sections; geological survey for different rocks; columnar sections correlation; preparing reports on the geological and environmental surveys; investigating the environmental circumstances of landslides and mining areas, as well as soil and water resources pollution.

0305312 Field Geotechnical Applications

(3 Credit Hours)

Prerequisite: (0305311)

A case study of slope stability for each student; geotechnical field measurements; preparation of cross sections; sampling and laboratory tests; mathematical analysis; writing of a technical report.

0305313 Geographic Information Systems Lab (1 Credit hour)

Prerequisite: (0305311)

ArcView Basics, Getting Data into ArcView, Working with tables, Editing Shape files, Querying and Analyzing Themes, GRID themes, working with Layouts

0305314 Instrumental Analyses in Geology

(1 Credit Hour)

Prerequisite: (0303106)

This lab aims at introducing the geology student into the techniques of instrumental analyses and identification of Earth's material i.e minerals, rocks, water chemistry etc; This lab will be given for the whole semester 3 hours a week and every lab will be preceded by an introduction on the theoretical basis of the different techniques; The techniques include: X-Ray diffraction, X-Ray fluorescence, Flame photometer, Atomic Absorption Spectroscopy, Inductively Coupled



Plasma, Mineral Separation using gravimetric and magnetic methods. Staining techniques; and Scanninng Electron Microscopy.

0305331 Applied Sedimentology

(2 Credit Hours)

Prerequisite: **0305231**

This course concentrates on the applied aspects of sedimentary rocks such as: paleoclimates, reservoirs for water and oil, source rock for oil, industrial rocks, landslides . In order to achieve that detailed study of sedimentary rocks is deeded: classification, types, properties, environment of deposition: clastics and non clastics, plus a lab and field.

0305332 Igneous and Metamorphic Petrology

(3 Credit Hours)

Prerequisite: **(0305231)**

Emplacement of magma; cooling of igneous bodies; phase diagrams in igneous systems; the magmatic differentiation processes; chemistry of igneous rocks; metamorphic reactions and facies; mineral reactions involving H_2O and CO_2 ; mineral reactions among solid solutions; material transport during metamorphism and chemistry of metamorphic rocks; (P-T-t) paths in regional metamorphic rocks; three hours laboratory each week and field trips are required.

0305341 Structural Geology

(3 Credit Hours)

Prerequisite: **(0305231)**

Principles of rock mechanics: forces, stress and strains diagrams; brittle deformation: faults, joints, folds, flexures, analyses and interpretation of faults; ductile deformation: folds, joints and flexures and their description; sequence of structural events; salt tectonics; global tectonics; three hours lab each week combined with field trips are required.

0305351 Principles of Geochemistry

(3 Credit Hours)

Prerequisite: **(0305231)**

Overview of the formation of the solar system and the synthesis of chemical elements; chemical equilibrium; acids and bases; distribution and geochemical classification of elements; salts and aqueous geochemistry; chemical weathering and mineral equilibria;



introduction to thermodynamics; oxidation-reduction reactions; isotope geochemistry: radioactive, radiogenic, and stable isotopes and their applications.



0305361 Principles of Hydrogeology

(3 Credit Hours)

Prerequisite: (None)

Precipitation: spatial and temporal distribution, measurements, equipment; evaporation: measurement and distribution; surface runoff: base and flood flows, hydrographs, discharge measurements, gauge stations; groundwater: infiltration, formation, movement; permeability and porosity, groundwater wells, well hydraulics; water chemistry; water in Jordan; three hours lab each week is required.

0305371 Applied Geophysics

(2 Credit Hours)

Prerequisite: (0305271)

The seismic refraction and reflection, resistivity and magnetic methods in exploration for: oil, gas, groundwater, mineral ores; travel-time equations of refracted waves from subsurface layers of constant velocities; dipping and faulted layers; seismic record sections: computer-processing techniques, analysis and interpretation of seismic reflection data, geophysical and geological interpretation; field and lab applications

0305372 Seismology

(3 Credit Hours)

Prerequisite: (0305101)

Seismology and its applications; earthquakes and plate tectonics; seismographs and seismological stations; earthquakes parameters; seismic phases; seismology and internal structure of Earth; earthquake deformations and seismic hazards; seismicity of Jordan: assessment and mitigation of earthquake hazards.

0305381 Earth Resources and the Environment (3 Credit Hours)

Prerequisite: (0305231)

Minerals: the foundations of society, the origin of mineral resources; energy from fossil fuels; energy for the future: nuclear energy; abundant metals; geochemically scarce metals; fertilizer and chemical minerals; water resources; soil resources: formation, types, distribution and uses; future resources; environmental impact assessment of resources exploitation and use; assessment of the environmental dangers of large projects.



0305382 Aqueous Geochemistry

(3 Credit Hours)

Prerequisite: (0305351)

Chemical equilibrium; activity models for solutes; pH as a master variable; Eh-pH diagrams; mineral solubility; aqueous complexes; ion exchange; carbonate system; weathering reactions; acid rain; chemical reactions that control surface and groundwater evolution in natural and engineered settings; computation methods and the use of computer programs for calculation of speciation and mass balance.

0305391 Engineering Geology

(3 Credit Hours)

Prerequisite: (0305101)

Geotechnics, soil mechanics, rock mechanics, field measurements and observations: boreholes and excavations, sampling, rock and soil mechanical tests in situ, and in laboratory. Geophysical methods in site investigations. Foundations; settlement, consolidation, slopes, waer pressures, leakages, grouting, water/rock and grout rock interactions.

0305392 Geologic Data Analysis

(3 Credit Hours)

Prerequisite: (0301131)

This course introduces the methods of mathematical quantitative and statistical data analysis to earth science students including univariate, multivariate, classification and spatial variability techniques. This course includes also a three hours computer lab each week.

0305393 Soil and Rock Mechanics

(3 Credit Hours)

Prerequisite: (0305391)

The rocks: engineering classification, exploitation, mechanical properties, deformation, in situ strength; rock mass properties: discontinuity analysis; rock slope stability; geomechanical classification for different purposes. Soil: genesis and structure, physical properties, engineering characteristics, site investigation, in situ testing, engineering classification; shear strength and effective stress concepts; slope stability; verification of foundation stability on



cohesive and granular soils; geologic factors in the design and construction of engineering projects as dams, tunnels...etc.



0305401 Geology of Jordan

(3 Credit Hours)

Prerequisite: (0305231)

This course deals with the evolution of Jordan from the precombrian until now. It studies the stratigraphy of the geological column, major structures, especially the Dead Sea Transform, mineral resources, energy resources, water budget of Jordan especially for the Jordan River Basin, plus field trip.

0305402 Earth and environmental sciences teaching (2 Credit Hours)

Prerequisite: (0305102)

This course deals recent approaches to science teaching and in particular Earth and environmental sciences; e.g. how to teach using critical thinking, scientific reasoning and discussions with the class room rather than narrative teaching. How to use illustrations: fossils, rock and mineral specimens, maps, compass, ...etc. Encouraging the teacher to conduct field trips and to get his samples from the local environment nearby his school. How to evaluate the students through teaching them the various types of examination questions. Working in groups and its importance, how to conduct an experiment and write its report, how to write report in general, present and discuss it, student file for their activities throughout the year.

0305403 Plate tectonics theory

(3 Credit Hours)

Prerequisite: (0305101)

A historical introduction; the basics of plate tectonics theory and the layered structure of the Earth; Types and characteristics of plate boundaries; the driving force of plates; movements of plates and measurements of their relative motions; the African plate and the history of its movements; the Arabian plate a detailed investigation; a detailed investigation of the Dead Sea-Jordan Transform; Discussion and the applications of plate tectonics theory.

0305411 Graduation Project

(2 Credit Hours)

Prerequisite: (0305341)

The students selects a topic in coordination with a staff member, then he conducts literature review in the library (Internet). The topic will include sample collection, and lab analyses. The obtained results will be interpreted and the present in a technical report.



0305421 Mineral Exploration

(3 Credit Hours)

Prerequisite: (0305381)

The results of mineral exploration represent the first step towards investment in geology. To get the student aquatinted with exploration steps and techniques The following topics are discussed in this course: Ores, Mineral Economics and Exploration; Mineralogy of Mineral Deposits; Geology of Mineral Deposits; Reconnaissance Exploration; From Prospect to Development; Remote Sensing; Geophysical Methods; Exploration Geochemistry; Evaluation Techniques; Feasibility Studies.

0305431 Industrial Geomaterials

(3 Credit Hours)

Prerequisite: (0305231)

Classification of industrial Earth's materials (rocks and minerals); origin of industrial rocks and minerals; cycles of principal elements of industrial materials in nature; deposits of industrial minerals; deposits of industrial rocks; deposits of building raw materials; prospecting for industrial Earth's materials; gemstones: classification, properties, origin and uses.

0305441 Remote Sensing techniques

(3 Credit Hours)

Prerequisite: (0305341)

Introduction to concepts and systems; photographs from aircraft and satellites; landsat images; Earth resources and environmental satellites; thermal infrared systems; satellite radar systems and images; digital image processing: Meteorologic, oceanographic, and environmental applications; oil and mineral exploration; three hours lab each weak is required.

0305451 Biogeochemistry

(3 Credit Hours)

Prerequisites: (0305351)

An introduction to biogeochemical cycles in the environment. Discusses processes and reactions governing cycles in the atmosphere, lithosphere, terrestrial ecosystems, freshwater wetlands and lakes, river estuaries, and the oceans. Outlines the global cycles of water, carbon, nitrogen, phosphorus, and sulfur. Group discussions will incorporate current topics in anthropogenic alterations of natural cycles that lead to ecosystem degradation



0305461 Water Resources Management

(3 Credit Hours)

Water resources, demands, supplies, planning, and development. Reuse and disposal of reused water. Economic valuation techniques and impact analysis. Human resources development. Social aspects of water resources development. Institutional, environmental, and legal aspects.

0305481 Environmental Geochemistry

(3 Credit Hours)

Prerequisite: (0305351)

The atmosphere; the terrestrial environment; material cycles; chemistry of continental waters; the major and minor ions chemistry of the oceans; global climate change and the various cycles: Carbon, sulphur, nitrogen, and phosphorous; chlorofluorocarbons and stratospheric ozone and SMOG formation; soil: geochemistry, reactions, and pollutants.

0305482 Environmental Geophysics

(3 Credit Hours)

Prerequisite: (0305271)

Importance of geophysics in environmental studies; geological and geophysical characteristics of some environmental problems: Landslides, cavities and sinkholes, groundwater pollution, dam problems; different geophysical techniques and field applications.

0305483 Environmental Impact Assessment (EIA)

(2 Credit Hours)

Prerequisite: (0305102)

Collection of the required data on each environmental component of a project or problem. Evaluation and comparison of the collected data, with the standards and regulations, prediction of the impacts on the biotic and abiotic parameters. Mitigation measures to minimize or eliminate impacts, impacts monitoring during and after the project execution. Live examples of EIA. On air and climate, archeological and dams projects.



0305491 Geology of Dams and Water Reservoirs (3 Credit Hours)
Prerequisite: (0305391)

This course studies rocks, formations and landslides structures making the formation and abutments of dams and reservoirs. It includes surface and subsurface investigations in wells, trenches and geophysical investigations. It also includes hydrological studies to determine the availability of water. Geotechnical studies is needed to judge the suitability of the foundation for a safe, stable and water tight dam.

0305492 Petroleum Geology (3 Credit Hours)
Prerequisite: (0305341)

Origin of oil and gas; source rock geochemistry; oil and gas migration and accumulation; role of groundwater movement in oil migration and formation of oil fields; reservoir rocks and oil traps; exploration for oil: surface and subsurface methods, drilling rigs and drilling mud, well logging; geologic cross-sections; sample description; stratigraphic logs and well correlation; isopach maps; three hours lab each week is required.