



Program: Geology
Degree Offered: Ph.D.

Plan	1/19	06	2005	PhD No.
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Study Plan

First: General Rules and Conditions:

1. This plan conforms to the valid regulations of programs of graduate studies.
2. Specialties allowed to enroll in the Ph.D. Program are:

- a) Holders of Master's Degree in Geology, Earth Sciences and Environment, and Environmental and Applied Geology.
- b) Holder's of Master's Degree in Engineering Geology.
- c) Holder's of Master's Degree in Space Sciences and Remote Sensing.

Second: Special Conditions: None

Third: The plan consists of **54 Credit Hours** distributed as follows:

1. Obligatory Courses (18 Credit Hours)

Course No.	Course Title	Credits	Prerequisites
0305931	Igneous Petrology	3	-
0305932	Sedimentary Rocks	3	-
0305941	Structural Geology	3	-
0305961	Hydrogeochemistry	3	-
0305981	Engineering Geology	3	-
0305982	Economic Geology	3	-

2. Elective Courses (**18 Credit Hours**) selected from the following

Course No.	Course Title	Credits	Prerequisites
0305901	Biostratigraphy	3	-
0305911	Subsurface Geology	3	-
0305921	Industrial Rocks & Minerals	3	-
0305933	Carbonate Rocks	3	0305932
0305934	Sequence Stratigraphy	3	0305932
0305935	Metamorphic Petrology	3	-
0305942	Remote Sensing	3	-
0305951	Environmental Isotopes	3	-
0305962	Groundwater modeling and hydrodynamics	3	-
0305971	Environmental Geophysics	3	-
0305972	Seismology and Geodynamics	3	-
0305983	Geostatistics	3	-
0305984	Paleoclimate	3	-
0305985	Enviromental Geology	3	-

3. Passing a qualifying exam (**0305998**).

4. Submission of an approved Thesis (**18 Credit Hours**) (**0305999**).

Course Description

0305901 Biostratigraphy (3 Credit Hours)

Prerequisite (None)

Introduction to paleontology and stratigraphy and the combination of those into biostratigraphy, the importance of fossils (Foraminifera, Ostracoda, Pollen and Spores) and stratigraphic concepts in the applied geosciences such as in petroleum and groundwater exploration, paleontological aspects and paleoenvironments, type of sedimentation, depths, temperature variations and shoreline boundaries, application on some rocks in Jordan, comparative worldwide studies with some Jordanian investigations

0305911 Subsurface Geology (3 Credit Hours)

Prerequisite (None)

Subsurface geological investigations for petroleum, water, minerals and constructions, techniques for exploration well and supervision, combining of subsurface and structural data, laboratory and practical applications, quantitative analysis for some electrical well logs and their use in drilling deep oil and water wells.

0305921 Industrial Rocks and Minerals (3 Credit Hours)

Prerequisite (None)

Abrasives, ceramic raw materials, chemical industry, construction materials, electronic and optical uses, fertilizer minerals, fillers, filters, and absorbents, fluxes, foundry sand gem materials, glass raw materials, mineral pigments, refractories, and drilling fluids.

0305931 Igneous Petrology (3 Credit Hours)

Prerequisite (None)

Overview of major igneous rocks associations. Phase equilibria in igneous rocks. Chemical petrology and modeling of igneous processes using major and trace elements and isotopes. Geothermometry and geobarometry in igneous rocks.

0305932 Sedimentary Rocks (3 Credit Hours)

Prerequisite: (None)

Carbonates (including dolomites): petrography, micro facies, depositional environments and sedimentation models, phosphorite: geochemistry, sedimentation models (present and past), petrography and X-ray diffractometry, cherts and other siliceous rocks: mineralogy, depositional environments with

XRD and SEM, evaporites: mineralogy, geochemistry, sedimentation models and petrography.

- 0305932 Carbonate Rocks (3 Credit Hours)**
Prerequisite: (None)
This course deals with the sedimentology of limestones and dolomites: mineralogy, structures and textures, porosity and permeability, classification, microfacies, depositional environments, diagenesis, ancient limestones, some economic aspects like hydrocarbons and building stones. The laboratory includes the petrography and microfacies of carbonates with field trips.
- 0305934 Sequence Stratigraphy (3 Credit Hours)**
Prerequisite: (0305732)
Interrelationships between sea-level changes, sediment supply and accommodation volume, cyclicity in sedimentary rocks, systems tracts, recognition and interpretation of systems tracts of the sedimentary sequence in the outcrops, cores and well logs, interpreting the seismic stratigraphy lines in order to produce the systems tracts and sequence cycles for a basin, studying examples from fluvial, shallow marine, deep marine, and carbonate sedimentary environments, basin evolution and oil exploration.
- 0305935 Metamorphic Petrology (3 Credit Hours)**
Prerequisite: (None)
Chemical reactions and chemical kinetics in metamorphic rocks. Mineral thermodynamics and Phase equilibria in metamorphic rocks. Metamorphic crystallization mechanisms. Geothermometry and geobarometry in metamorphic rocks.
- 0305941 Structural Geology (3 Credit Hours)**
Prerequisite: (None)
Active tectonics and tectonic geomorphology. Whole Earth structure and plate tectonics. Rifting and extensional tectonics. Fold-thrust belts. Strike-slip tectonics. The course includes three hours weekly for lab and/or field trips to study different geological structures and make structural analyses.
- 0305942 Remote Sensing (3 Credit Hours)**
Prerequisite: (None)
Introduction, general physical principles, diversity of remote sensing techniques, geophysical remotely sensed airborne and satellite data and images, roles and limitations of Landsat, Spot, Ikonos, in studying geological, natural or man made

processes, review of map projections, coordinates, positioning systems, GPS (American system), Galileo (future European system), radar interferometry, applications, data presentation and a GIS case study.

0305951 Environmental Isotopes (3 Credit Hours)

Prerequisite: (None)

This course examines the use of radiogenic and stable isotopes as tracers of biogeochemical processes. Topics in the course include the theoretical basis for radiogenic and stable isotope chemistry, and the application of isotope studies in ecological, hydrological, and geochemical studies. Standards and measurements of stable and radioactive isotopes. Stable isotopes: oxygen, hydrogen, carbon, sulphur, and nitrogen. Radioisotopes: tritium, carbon 14, chlorine, krypton, argon, uranium series. Isotopes as indicators of environmental change.

0305961 Hydrogeochemistry (3 Credit Hours)

Prerequisite: (None)

Introduction, chemical thermodynamics, solubility and oxidation-reduction equilibria, process kinetics, surface and colloidal system chemistry, applications on purification and treatment of water and wastewater; coagulation, precipitation, ion exchange and adsorption, pollution and remediation measures of the environment, utilization of the water-rock/soil interaction and geochemical modeling in the field of environmental impact assessment.

0305962 Groundwater Modeling and Hydrodynamics (3 Credit Hours)

Prerequisite: (None)

Groundwater flow systems, variations and changes in quantity and quality induced through time and due to aquifers variabilities, relationships to oil and gas field formation (hydrodynamic traps), case studies on regional systems, detailed discussions on the different types of groundwater flow models (finite difference and finite element) for the different aquifer conditions as well as transport models, and usage of program packages on mathematical modeling.

0305971 Environmental Geophysics (3 Credit Hours)

Prerequisite:

Introduction, geophysics and environmental problems, earthquakes and earthquake hazard; assessment and mitigation of earthquake risk; landslides and geological factors, the role

of geophysics in the study of landslides, dams and water-reservoirs and environmental problems, and field applications.

0305972 Seismology and Geodynamics (3 Credit Hours)

Prerequisite: (None)

Introduction, plate tectonics and earthquakes, mathematical introduction, the inverse problems theory concepts, the physical theory of earthquakes, barriers and asperities, seismic sources and mechanisms, seismotectonic applications, induced seismicity, and seismicity of the Arabian plate and the Jordan Dead Sea Transform, feasibility and environmental impact of earthquake studies, seismic risk hazard, and earthquake prediction.

0305981 Engineering Geology (3 Credit Hours)

Prerequisite: (None)

Investigation fundamentals, elements of investigation, types of investigations, engineering properties of soils, engineering properties of rocks, engineering classification of rocks, discontinuities in the rock masses, recording discontinuity data, shear strength of discontinuities, field estimate of joint roughness coefficient (JRC), rock mass characterization, geomechanics classification, use of rock mass classification for estimating geological strength index (GSI), analysis of structurally controlled instability, slope stability in rock masses, applications of engineering geology in dams, reservoirs, tunnels, highways and bridges.

0305982 Economic geology (3 Credit Hours)

Prerequisite: (None)

Genesis and localization of metallic and nonmetallic ores, the development of modern theories of ore deposition, ore-bearing fluids, migration of ore-bearing fluids, deposition of ores, alteration and gangue, paragenesis and zoning, and classification of ore deposits.

0305983 Geostatistics (3 Credit Hours)

Prerequisite: (None)

This course aims at introducing the student to the field of geostatistics (ore reserve calculations) in six chapters: introduction, the semi-variogram, the volume-variance relationship, estimation, kriging, and practice

0305984 Paleoclimate (3 Credit Hours)

Prerequisite: (None)

This course explores climate change from the geological perspective. It will include: Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters (Milankovitch cycles). Examination and analysis of past climate records ranging from historical documentation to geological, ecological and geochemical proxies (e.g. sediments, fossils, tree ring analysis, O and C isotopes of skeletal carbonates and soils). Dating methods (e.g. C-14 and U/Th...etc.) will be used to constrain and correlate climatic periods. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last 1 million years).

0305985 Environmental Geology (3 Credit Hours)

Prerequisite: (None)

Different aspects of the natural and man's activities hazards on the earth, taking in consideration the following issues: Organic and inorganic pollutants in water, soil and air including the different models govern the pollutants behaviour, natural hazards, such as volcanoes, earthquakes and landslides, mitigation measures used to protect and/or reduce the man made and/or natural hazards, environmental impact assessment on the major projects, strategic environmental assessment and its relation to development plans and sustainable developments.