



**Al al-Bayt University**  
**Institute of Earth and Environmental Sciences**

**Academic Plan for M.Sc. in Applied Geology**  
**(Exam Track)**

**2020-2021**

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| <b>Applied Geology and Environmental<br/>Sciences Department</b> |
| <b>Institute of Earth and Environmental Science</b>              |
| <b>Al al-Bayt University</b>                                     |

**2020-2021**

## **Academic Plan for M.Sc. in Applied Geology (Exam Track)**

**Program Title (English): M.Sc. in Applied Geology**

**Program Title (Arabic): الماجستير في الجيولوجيا التطبيقية**

### **(1) General Rules and Conditions**

- 1. This plan matches the regulations of general frame of M.Sc. programs instructions at Al al-Bayt University**
- 2. Specialties that can be accepted in this program are:**
  - 1- B.Sc. degree in Geology, Earth and Environmental Sciences, Applied and Environmental Geology
  - 2- B.Sc. Degree in Geological Engineering
  - 3- B.Sc. Degree in Environmental Engineering and Environmental Sciences
  - 4- B.Sc. Degree in Civil Engineering, Chemical Engineering
  - 5- B.Sc. Degree in Geographic Information Systems and Remote Sensing
  - 6- B.Sc. Degree in Chemistry and Biology
  - 7- B.Sc. Degree in Mining Engineering.
  - 8- B.Sc. Degree in Land and Water Management and Agricultural Engineering
  - 9- B.Sc. Degree in Physical Geography

### **(2) Program Courses: This plan consists of (33) Credit Hours distributed as follows:**

- 1- Obligatory Courses: (21) Credit Hours
- 2- Elective Courses: (6) Credit Hours
- 3- Graduation Project: (6) Credit Hours

### **(3) Complementary Courses: Determined according to the instructions of graduate studies at Al al-Bayt University**

**a. Obligatory Courses: (21) Credit Hours comprises of the following courses:**

| No.          | Course Number | Course Name                  | Credit Hours |
|--------------|---------------|------------------------------|--------------|
| 1            | 0803701       | Sedimentology                | 3            |
| 2            | 0803702       | Advanced Geochemistry        | 3            |
| 3            | 0803703       | Advanced Geophysics          | 3            |
| 4            | 0803704       | Advanced Mineralogy          | 3            |
| 5            | 0803709       | Advanced Structural Geology  | 3            |
| 6            | 0803712       | Applied Hydrogeology         | 3            |
| 7            | 0803722       | Advanced Engineering Geology | 3            |
| <b>Total</b> |               |                              | <b>21</b>    |

**b. Elective Courses: (6) Credit Hours to be chosen from the following courses:**

| No. | Course Number | Course Name   | Credit Hours | Prerequisite |
|-----|---------------|---|--------------|--------------|
| 1   | 0803705       | Advanced Clay Mineralogy  | 3            | 0803704      |
| 2   | 0803706       | Clastic Sedimentary Rocks   | 3            | 0803701      |
| 3   | 0803707       | Advanced Igneous and Metamorphic Rocks                            | 3            | 0803704      |
| 4   | 0803708       | Stratigraphy and lithofacies                                      | 3            | 0803701      |
| 5   | 0803710       | Ore Minerals Deposits   | 3            | -            |
| 6   | 0803716       | Industrial Rocks and Minerals                                     | 3            | 0803704      |
| 7   | 0803717       | Subsurface Geology  | 3            | -            |
| 8   | 0803718       | Special Topics in Geology   | 3            | -            |
| 9   | 0803720       | Environmental Systems & Environmental Impact Assessment           | 3            | -            |
| 10  | 0803724       | Micropaleontology   | 3            | -            |
| 11  | 0803731       | Applications of Remote Sensing and Geographic Information Systems | 3            | -            |

**c. Graduation Project: (6) Credit Hours**

| Course Number | Course Name        | Credit Hours |
|---------------|--------------------|--------------|
| 0803740       | Graduation Project | 6            |

## Advisory Plan for the M.Sc. Program in Applied Geology

### First Year

| First Semester |                     |              | Second Semester |                             |              |
|----------------|---------------------|--------------|-----------------|-----------------------------|--------------|
| Course Number  | Course Name         | Credit Hours | Course Number   | Course Name                 | Credit Hours |
| 0803701        | Sedimentology       | 3            | 0803709         | Advanced Structural Geology | 3            |
| 0803704        | Advanced Mineralogy | 3            | 0803703         | Advanced Geophysics         | 3            |
| -              | Elective Course     | 3            | 0803712         | Applied Hydrogeology        | 3            |
| <b>Total</b>   |                     | <b>9</b>     | <b>Total</b>    |                             | <b>9</b>     |

### Second Year

| First Semester |                              |              | Second Semester |                    |              |
|----------------|------------------------------|--------------|-----------------|--------------------|--------------|
| Course Number  | Course Name                  | Credit Hours | Course Number   | Course Name        | Credit Hours |
| 0803702        | Advanced Geochemistry        | 3            | 0803799         | Graduation Project | 6            |
| -              | Elective Course              | 3            | -               | -                  | -            |
| 0803722        | Advanced Engineering Geology | 3            | -               | -                  | -            |
| <b>Total</b>   |                              | <b>9</b>     | <b>Total</b>    |                    | <b>6</b>     |

### Courses Offered by the Department

| No. | Course Number | Course Name   | Credit Hours |
|-----|---------------|---|--------------|
| 1   | 0803701       | Sedimentology   | 3            |
| 2   | 0803702       | Advanced Geochemistry   | 3            |
| 3   | 0803703       | Advanced Geophysics   | 3            |
| 4   | 0803704       | Advanced Mineralogy   | 3            |
| 5   | 0803705       | Advanced Clay Mineralogy  | 3            |
| 6   | 0803706       | Clastic Sedimentary Rocks   | 3            |
| 7   | 0803707       | Advanced Igneous and Metamorphic Rocks                            | 3            |
| 8   | 0803708       | Stratigraphy and Lithofacies                                      | 3            |
| 9   | 0803709       | Advanced Structural Geology                                       | 3            |
| 10  | 0803710       | Ore Minerals Deposits   | 3            |
| 11  | 0803712       | Applied Hydrogeology  | 3            |
| 12  | 0803716       | Industrial Rocks and Minerals                                     | 3            |
| 13  | 0803717       | Subsurface Geology  | 3            |
| 14  | 0803718       | Special Topics in Geology   | 3            |
| 15  | 0803720       | Environmental Systems & Environmental Impact Assessment           | 3            |
| 16  | 0803722       | Advanced Engineering Geology                                      | 3            |
| 17  | 0803724       | Micropaleontology   | 3            |
| 18  | 0803731       | Applications of Remote Sensing and Geographic Information Systems | 3            |

## **Courses Description**

### **0803701 Sedimentology**

**3 Credit Hours**

**Prerequisite: -**

Sediments, their origin, formation and classification, depositional environments and microfacies, marine depositional environments and their characterization methods, petro-logical facies, depositional environments and their economic importance, weathering and depositional cycles, clastic and non-clastic sediments, sedimentary processes, sedimentary rocks textures and their various characteristics, sedimentary structures, sedimentary rocks classification, sedimentary rocks types.

### **0803702 Advanced Geochemistry**

**3 Credit Hours**

**Prerequisite: -**

Analysis of Geochemical Data, Geological processes and their geochemical signatures for Igneous rocks, Analytical methods in Geochemistry, Sources of error in Geochemical analysis, Using major elements, trace elements data for Rock classification, Variation, spider and vector diagrams. Geological controls on the distribution of trace elements (a-batch melting, b-fractional melting, c- in situ crystallization. Differentiation between tectonic environments using geochemical data. Thermodynamics, binary phase diagrams.

### **0803703 Advanced Geophysics**

**3 Credit Hours**

**Prerequisite: -**

Seismic methods and their importance in exploration, analyses and interpretation of seismic refraction data for geological models of constant and variation velocities. Analyses and interpretation of seismic reflection data and set up geological models. Gravity method and their importance in exploration, gravitational effects of various earth geometrical bodies. Gravitational anomalies isolation methods. Electrical methods and their importance in exploration, Analyses and interpretation electrical data quantitatively. Magnetic methods and their importance in exploration. Quantitative and Qualitative interpretation methods of magnetic data.

### **0803704 Advanced Mineralogy**

**3 Credit Hours**

**Prerequisite: -**

Introduction in advanced crystallography; [crystal morphology, crystal stability, unit cell, crystal lattice, crystal symmetry and crystal systems]. Mineral Chemistry; Atomic bonding, Coordination number, Pauling rules for ionic structure, Substitution ions [interstitial solid solution, omission solid solution]. Mineral (crystal) chemical and morphological analysis i.e.; XRD, XRF and SEM. Mineral physical properties. Non silicate mineral classification, native elements, sulfides, oxides, hydroxides, halides, carbonates, nitrates, borates, sulfates, chromates, phosphates, tungstates, molybdenate, arsenates. Silicate minerals: nesosilicates, sorosilicates, cyclosilicates, inosilicates, phyllosilicate, tectosilicate. Minerals Gems., Mineral assemblages and igneous, sedimentary and metamorphic rocks.

**0803705    Advanced Clay Mineralogy****3 Credit Hours****Prerequisite: 0803704**

Introduction, composition of clay minerals, classification of clay minerals, x-rays, identification of clay minerals, chemistry of clay minerals, kaolin groups, serpentine, smectite, illite, chlorite, vermiculite. Quantitative analysis of clay minerals, genesis of clay minerals, engineering properties of clays, clay minerals geochemistry, zeolite minerals, clay minerals in Jordan: occurrences, characteristics and origin.

**0803706    Clastic Sedimentary Rocks****3 Credit Hours****Prerequisite: 0803701**

Mineral composition of sandstone, heavy metals and post-deposition sequential. Burial depth, geochemistry, their relation with tectonic, paleo-climate and depositional environment. In addition, studying terrestrial, transitional and marine depositional environments to infer the paleo depositional environment in clastic sedimentary lithological record.

**0803707    Advanced Igneous and Metamorphic Rocks****3 Credit Hours****Prerequisite: 0803704**

Igneous rocks genesis (magma generation), classification of igneous rocks mineralogy and chemistry. Thermodynamics, phase equilibria in igneous processes, magmatic processes, igneous rock assemblages at different tectonic settings. Thermochemical reactions and mineral facies in metamorphic rocks, material transport during metamorphism, geothermometry and geobarometry, pressure-temperature-time paths in regional metamorphic rocks.

**0803708    Stratigraphy and Lithofacies****3 Credit Hours****Prerequisite: 0803701**

An introduction about the basic concepts of stratigraphy and lithostratigraphic, biostratigraphic and chronostratigraphic units, branches of stratigraphy and its subdivisions, litho and biocorrelation, direct application of the global stratification system to the stratigraphy of Jordan, preparation of a detailed report of lithostratigraphic and biostratigraphic units that are studied in the field and the separation of fossils, especially the foraminifera group, to determine the different facies, based on their fossil content; drawing maps of lithofacies to reconstruct the basins and ancient environments; visiting stratigraphic profiles to study the litho and biofacies changes and their fossil content.

**0803709    Advanced Structural Geology****3 Credit Hours****Prerequisite: 0803701**

The different structural elements and their relationships with stress and strain, indications of stress and strain and methods of measuring and calculating them. Stereographic projection of planes and lines and their structural analysis, different field skills in the use of various geological compasses, methods of drawing geological cross sections and maps with different scales and locating structural information on them.

**0803710 Ore Minerals Deposits****3 Credit Hours****Prerequisite: -**

Introduction to ore minerals, theories of ore minerals deposits, the hydrothermal deposits, hydrothermal bearing ore deposits migration and factors control that. Ore mineral deposits, the geological structures and their effect on ore mineral deposits, factors control ore deposition, the textures of ore deposits (replacement), classification and origin of ore minerals deposits.

**0803712 Applied Hydrogeology****3 Credit Hours****Prerequisite: -**

Introduction to groundwater, origin of groundwater, groundwater and the hydrologic cycle, vertical distribution of subsurface water, groundwater recharge and discharge, geological formations and aquifers, types of aquifers, groundwater levels in confined, unconfined and perched aquifers, groundwater contour maps, groundwater flow directions, determination of groundwater catchment area (groundwater contribution area), wells and springs, physical properties of aquifers (porosity, effective porosity, permeability, hydraulic conductivity, transmissivity, homogeneity, ...etc.), Darcy's law, Darcy velocity, karst aquifers, introduction to groundwater quality and main parameters affecting groundwater quality, groundwater protection against pollutants, wells pumping tests (concept and used methods), calculating the hydrogeological parameters using pumping tests analysis results, the hydrogeology of Jordan.

**0803716 Industrial Rocks and Minerals****3 Credit Hours****Prerequisite: 0803704**

Introduction, difference between ore deposits and industrial rocks & minerals, overview of the industrial minerals (characteristics of the industrial minerals sector, classification of industrial minerals and rocks, world distribution of industrial minerals deposits, international trade in industrial minerals, mine safety and health law environmental law for industrial minerals and rocks sustainable development and industrial minerals), markets and uses (absorbents and desiccants , construction uses, cosmetics, electronic and optical materials, environmental uses, fertilizers, refractories, nanomaterials, well drilling materials.. etc.), industrial rocks & minerals in Jordan

**0803717 Subsurface Geology****3 Credit Hours****Prerequisite: -**

Geophysical exploration methods; seismic refraction and seismic reflection methods, seismic Stratigraphy, well logging, subsurface facies analysis, core cutting description, geophysical well logging, subsurface structural maps, basin analyses, reservoirs characteristics and evaluation, hydrocarbon traps. Reservoir modeling.

**0803718 Special Topics in Geology****3 Credit Hours****Prerequisite: -**

Advanced methods to study the newest theories, techniques and scientific research methodologies used in specified topic in one of the geological fields.

**0803720 Environmental Systems &  
Environmental Impact Assessment****3 Credit Hours****Prerequisite: -**

Introduction: Eco-systems, their definitions, importance, characteristics and different relationships. Environmental impact assessment (EIA), development of EIA such as "environmental assessment strategy" and "social impact assessment", principles and administrative procedures, audience contribution, EIA processes ( Initial work, test, assessment, reduction management and impacts, report writing, reviewing, decision making, observing, conduction), methodology (lists, matrices, models, expert systems, etc), case studies.

**0803722 Advanced Engineering Geology**

**3 Credit Hours**

**Prerequisite: -**

Introduction: Relationships among geology, engineering and engineering geology. Intact rock and rock mass parameters in engineering applications. Geotechnical site investigations. Basic engineering geological concepts, problems and remedial measures related to dam sites, tunnels, roads and slopes. Earthquakes and related problems. Engineering problems related to soils Index and physical properties of soils and their engineering classification. Principle of effective stress concept. Compressibility and consolidation theory. Triaxial compression and shear strength. Soil behavior under different stress conditions. Settlement concept.

Index and mechanical properties of rocks. Introduction to stress and strain analyses and elasticity, Mechanical behavior of rock material and rock mass. Basic failure criterion. Applications of rock mechanics in engineering projects and introduction to rock mass classification systems.

**0803724 Micropaleontology**

**3 Credit Hours**

**Prerequisite: -**

A comprehensive course dealing with fossil micro-organisms such as: Foraminifera: structures, origin, shape, apertures, wall composition, mode of life, selected families and genera for analyzing, history & Age. Ostracoda: Structures, classification, ecology, stratigraphic range, methods of study-post Paleozoic ostracodes. Pollen & Spores: general structures, classification, morphology, & stratigraphic palynology. Three days field trip to important stratigraphic sites in the Aqaba-Madawwara districts.

**0803731 Applications of Remote Sensing and Geographic Information Systems**

**3 Credit Hours**

**Prerequisite: -**

Aerial imagery: introduction, use, hardware, geological phenomena recognition; remote sensing: concept, basic definitions; geometric correction of space images; Data processing: classification, filtering; uses for the environment and water resources; computer applications; GIS: Principles, components and management; collection and organization of information and data; modeling; results and computer applications.

Remote sensing and GIS; applications in the environment and water resources; water surveys: Instruments, maps, interpretation; geophysical surveys: different methods, Hardware, interpretation.

