Engineering Geology is Backbone of Civil Engineering

Engineering Geology
1. Introduction

2nd semester - 2012-2013

Eng. Iqbal Marie

The Hashemite University
Faculty of Engineering
Course Syllabus

Course Title:	**Engineering Geology** **Course Number:** **110401436**
Department:	Civil Engineering **Designation:** Compulsory
Prerequisite(s):	(0103107+0401212
Instructor:	Iqbal Marie **Instructor's Office:** E 3005
Instructor's e-mail:	iqbal@hu.edu.jo
Office Hours:	Mon 8-9:30, Sun. + Tue 11-12
Time:	12:30-1:30 **Class Room:** E2019 Mon & Wed
Course description:	Earth material, rock minerals and their characteristics, rock types and classification, rock cycle, engineering properties of rocks, weathering and weathered rocks, geologic structures, site investigation, mass movement and rock slopes, earthquakes, surface and underground water. **Lab.:** Site investigation, rock minerals, rocks Identification, geologic structures, abrasion of rock, rock deformation and strength, topographic maps .
Textbook(s):	Principles of Engineering Geology, by: Rebert B … , John Wiley & Sons
Topics covered:	1. Introduction { course objectives and relevance to engineering} 2. Structure and composition of earth 3. Minerals (composition, characteristics, groups) 4. Rocks cycle, and the three rock families Igneous Activity and Igneous Rocks . Weathering, Sediments, and sedimentary rocks Metamorphism and Metamorphic rocks 5. Engineering Properties of rocks (foundation and materials as aggregates) 6. Structural features (folds, Joints, Faults) 7. Mass movements and slope processes 8. Site investigation 9. Surface water and ground water 10. Subsurface geology, condition of stress at depth (for excavation, tunneling highways, …) 11. Earthquakes, (interpreting earthquakes, effect of earthquakes on structures) 12. Geology of Jordan Laboratory : - Mineral properties and identification - Igneous rock identification (ID) - Sedimentary rock ID - Metamorphic rock ID - Slake Durability - Strength of rocks (point load test) , indirect tensile strength , Indirect Tensile Strength (Brazilian disc method - RQD - Site investigation and sample preparation - Geological maps (surfer software)
Class/laboratory schedule:	- **2 class sessions each week; 50 minutes each + three-hour laboratory session per week.**

Grading Plan:

First Exam	(20 Points)	**Wed 20 /3/2013 (12:30-1:30) pm**
Second Exam	(20 Points)	**Wed 24/4 / 2013 (12:30-1:30) pm**
Lab	(20 points)	
Final Exam	(40 Points)	Will be announced by the registrar

Aims:

1. **To introduce civil engineering aspects of geology**
2. **To show how basic geological features can affect the performance of engineering construction and the means by which such effects may be predicted and evaluated.**
3. **Introducing the geological maps and plotting simple maps using software.**
4. **Predicting any geological hazards and the engineering solutions to minimize their effects**

Geology

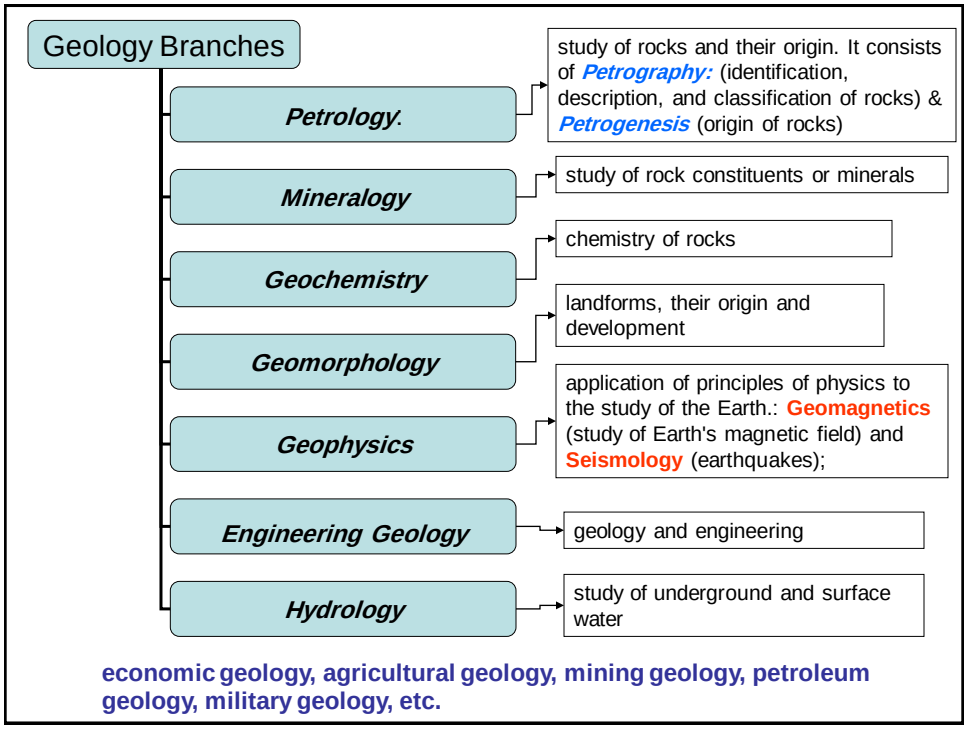
Geology is the science of the Earth, its composition and structure, its history, and its past plant and animal life.

It is divided into two major groups.

Physical Geology deals with the materials that constitute the Earth (soils and rocks), the structures and surface features of the Earth, and the processes that created these structures.

Historical Geology deals with the history of the Earth.

Geology is further divided into a number of branches according to the subject matter that is covered or to the industrial or commercial applications



The civil engineer should have at least one course in geology that provides familiarity with the basic Earth materials, processes, an awareness of change through time, and ideally how this knowledge applies to the success of an engineering project.

Only this minimal training can permit communication with geologists who will perform the actual site characterization.

- **As an engineer – You must be able to recognize the risk or problem**
- **If the problem is known then you can suggest an engineering solution**
- **If you do not recognize the geological problems the engineering construction can be at great risk**

Engineers use knowledge of geology to design, protect and correct structures

Definition and scope of engineering geology

Engineering geology:

Scientific discipline concerned with the application of geologic knowledge to engineering problems such as:

- **reservoir design and location,**
- **determination of slope stability for construction purposes,**
- **determination of earthquake, flood, or subsidence danger in areas considered for roads, pipelines, bridges, dams, or other engineering works.**

Engineering geologic studies may be performed during:

- **the planning,**
- **environmental impact analysis,**
- **civil or structural engineering design, value engineering and construction phases of projects**

Some of the major activities of Engineering Geologists include the following:

1. The investigation of **foundations for all types of major structures**, (dams, bridges, airports, large buildings, and towers.)
2. The evaluation of geologic conditions along **tunnel, pipeline, canal, railway, and highway routes.**
3. The exploration and development of sources of rock, soil and sediment for use as **construction material.**
4. The investigation and development of surface and **groundwater resources**.
5. The evaluation of **geologic hazards** such as landslides, faults and earthquakes, radon, asbestos, subsidence, expansive and collapsible soils, expansive bedrock, cavernous rock, and liquefaction.
6. Evaluation of geologic conditions (including **groundwater)** affecting residential, commercial, and industrial land use and development.
7. **Construction geology**, including slope stability, dewatering, sub-drains, grouting considerations, and excavatability.
8. Safe siting and geologic design considerations for **waste management and disposal facilities** and to assist in establishing the bases for remedial actions for mitigation of related environmental threats from un-engineered and uncontrolled waste disposal.

Exploration of a site

1. Preliminary investigation using published information and other existing data
2. A detailed geological survey of the site , with a photography study
3. Applied geophysical survey to provide information about the subsurface geology
4. Boring, drilling and excavation to provide confirmation of previous results and quantitative detail, at critical points on the site
5. Testing of soils and rocks to assess their suitability , specially their mechanical properties either is situ or from sample

Assessment of geologic hazard and risk caused by proposed human activities (feasibility and site selection)

- Dams
- Railway
- highways

Highway engineering considerations example

1. Highway alignment, locations
2. Subsurface exploration along highway centerline and bridge foundations;
3. Classification of materials for excavation, rock versus common borrow soil
4. Cut and fill volumes determined to minimize the need of offsite borrow pits or rock waste areas;
5. Recommend angle of back slope (rock cut slope) based on rock conditions;
6. Groundwater aspects related to construction;
7. Evaluation of landslide-prone areas;
8. Recognition of compressible soil materials;
9. Construction materials, location and inventory;
10. highway effects on adjacent landowners;

Role of Engineer in Geological Hazards:

Assessing Risks

Avoiding Risks

Preventing damage

Predicting Impact

Civil engineering works are all carried out on or in the ground. Its properties and processes are therefore significant – both the strengths of rocks and soils, and the erosional and geological processes which subject them to continual change.

Civil engineering design can accommodate almost any ground conditions which are correctly assessed and understood.

SOME ENGINEERING RESPONSES TO GEOLOGICAL CONDITIONS

Geology	Response
Soft ground and settlement	Foundation design to reduce or redistribute loading
Weak ground and potential failure	Ground improvement or cavity filling; or identify and avoid hazard zone
Unstable slopes and potential sliding	Stabilize or support slopes; or avoid hazard zone
Severe river or coastal erosion	Slow down process with rock or concrete defences (limited scope)
Potential earthquake hazard	Structural design to withstand vibration; avoid unstable ground
Potential volcanic hazard	Delimit and avoid hazard zones; attempt eruption prediction
Rock required as a material	Resource assessment and rock testing