American University of Beirut
Department of Civil & Environmental Engineering
Spring 2015-2016

CIVE 370
CONSTURCTION MATERIALS and TECHNOLOGIES
COURSE SYLLABUS

Course Title	**:**	Construction Materials and Technologies
Course Description	:	A Lecture and Laboratory Course that aims to acquaint students with different construction materials, their characteristics, and the relevant tests according to international standards.
Credits	:	3 credits
Instructor(s)	:	Mr. Helmi Khatib and Dr. Ghassan Chehab
Office Hours	:	Dr. Chehab: Bechtel – 4th floor Mr. Khatib: M/T/W/Th from 10:00 to 11:00 am, Irani Building Room 110b
Location	:	Lecture: Irani Oxy Engineering Complex – Room 225 Lab: Geotechnical Lab, Irani Building, Level 1, Room 111
Textbook	:	***"Materials for Civil and Construction Engineers",*** M. Mamlouk and J. Zaniewski, Pearson, latest edition
References	:	1- ***"Fundamentals of Building Construction: Material and Methods",*** Edward Allen & Joseph Iano, 1998 2- ***Construction: Principles, Materials, Methods"***, Harold B.Olin, Walter H. Lewis, Sixth ed., 1994 3- ***"Civil Engineering Materials"***, Second Edition, Shan Somayaji

Course Objective: The objective of this course is to introduce civil engineering students to the usage of different construction materials and their applications.

Course Outcome: After completion of this course:

- Students will be able to measure and/or monitor material properties through standardized experimental protocols.
- Students will understand the empirical/mechanistic properties and performance of commonly used construction materials.
- Students will understand the importance of professional and ethical responsibilities in selecting proper materials and material characteristics on structural safety and performance.
- Students will be able to conduct research on specific issues related to construction materials.
- Students will develop their life-long learning skills by conducting studies and reporting results in relation to new or innovative construction materials.
- Students will have some practice in performing forensic case studies on structures within a team environment.

Attendance Policy: A total of three absences for the semester will be permitted w/o penalty. For every absence beyond the third, **5 points will be deducted from the final course grade**. The student may seek to reverse the above, by presenting a petition along with a documented valid excuse explaining the reasons for absences, to the FEA Academic committee.

Exam: There will be two written Exams, **(30 % each)**.

Lab Sessions:

Sessions are divided as follows: *30 min* Lecture and *90 min Hands-on experiment*

Lab Procedures:

- The class will be divided into 4 groups; every group is assigned to complete 1 project and submit lab reports.
- As a pre-lab duty, the student shall read and understand the corresponding chapter in the textbook.
- **Each group will cleanup and be responsible for his work area and equipment.**

Daily assignments, laboratory reports, presentations and drop Quizzes (15 %)

Site project - Group work (10 %):

Every group of students is required to visit a construction site or a construction material factory (Buildings, roadways, masonry and tile plants, concrete and asphalt plants, quarries), in order to report and record the use of materials in construction, and step-by-step construction procedures.

Lab testing term project- Group work (15%)

- The performance of students in this project will be evaluated in accordance with several performance indicators (PIs) as outlined below. The performance indicators are designed to measure the level of students' achievement of ABET Program Student Outcome b *"An ability to design and conduct experiments as well as to analyze and interpret data,"*
- **The general PIs are as follows:**
  - **PI b.1- Ability (of students) to design an experiment.**
  - **PI b.2- Ability to conduct an experiment, and**
  - **PI b.3- Ability to analyze and interpret data.**

COURSE OUTLINE

Topic 1: AGGREGATES
Session 1:

Lecture Part	Lab Work
Types of Aggregates Coarse vs. Fine Physical Characteristics of Aggregates -Size and Gradation (Fineness Modulus) -Shape and Texture-Flakiness and Elongation -Absorption and Specific Gravity -Resistance to Degradation and Abrasion	***Introduction to lab work and projects*** ***Measuring devices*** ***Lab tour*** ***Forming groups***

Topic 2: CONCRETE
Session 2:

Lecture Part	Lab Work
Cement -Types of Portland Cements and their uses Mix Design using ACI tables Workability -The effect of water reducer /on workability. -The effect of water content on workability	***Sieve Analysis of Aggregates*** ***Specific Gravity and Absorption of Coarse Aggregate*** ***S Bulk Unit Weight and Voids in Aggregate*** ***Specific Gravity and Absorption of Fine Aggregate*** ***L.A. Abrasion Test***

Session 3:

Lecture Part	Lab Work
Additives -Chemical Additives: AEA, retarders, etc. -Mineral Additives: fly ash, silica fume, etc. Compaction Methods -Rodding versus Vibration Techniques Molding Cylinders/Cubes and Curing Methods -Importance of curing, setting time, effect of humidity, temperature and wind, etc. Compressive Strength	***Acceptance tests on cement:*** ***Normal consistency*** ***Time of setting*** ***Soundness*** ***Fineness*** ***Strength*** ***Slump of Freshly Mixed Portland Cement Concrete p.496*** ***Unit Weight and Yield of Freshly Mixed Concrete p.499*** ***Making and Curing Concrete Cylinders and Beams p.506*** ***Capping Cylindrical Concrete Specimens with capping Compound p. 510*** ***Compressive Strength of Cylindrical Concrete Specimens p. 512*** ***Flexural Strength of Concrete p. 515***

Topic 3: ASPHALT

Session 4:

Lecture Part	Lab Work
Asphalt Grading Asphalt-Concrete Mix Design Road structure and Construction -Structural Layers: Subgrade, Sub-base, Base, Asphalt Concrete (AC) Layer -Mixing, Placement, and Compaction of Asphalt Layer	***Penetration Test*** ***Marshall Test*** ***Mix Preparation*** ***Working on the lab project***

Topic 4: STEEL

Session 5:

Lecture Part	Lab Work
Stress-Strain Diagram of Steel -Ultimate Strength -Yielding Strength -Percent Elongation -Area Reduction ASTM Specs for Reinforcing Bars Corrosion-Corrosion mechanism -Induced problems and failures -Mitigation techniques	***Tension Test*** ***Different groups may test different bar sizes. The ASTM specs include tensile strength and yield strength for different grades, and minimum percent elongation for different bar sizes.*** ***Impact test on steel*** ***Hardness test on steel*** ***Working on the lab project***

Topic 5: MASONRY

Session 6:

Lecture Part	Lab Work
Definition Stone and brick with binding material (mortar). Uses in walls -Interior vs. exterior -Load-bearing vs. non load-bearing -Solid/hollow vs. framed. Properties of bricks -Color, texture, size, density -Compressive Strength, Tensile Strength -Thermal Conductivity, Fire Resistance.	***Rebound Number of Hardened Concrete 518*** ***Penetration Resistance of Hardened Concrete 520*** ***Testing of Concrete Masonry Units 523*** ***Test the lab project samples***

Topic 6: WOOD

Session 7:

Lecture Part	Lab Work
Structure and Chemical Composition -Cellulose-Hemicelluloses-Lignin -Extractives Types of Wood:-Hardwood—Softwood Physical and mechanical properties of wood (moisture content, density and strength...) Defects in Wood Treatment and Durability	***Test the lab project samples***

Topic 7: COMPOSITES

Session 8:

Lecture Part	Lab Work
Definition • Composite materials can be classified as ***Microscopic*** or ***Macroscopic*** Uses of composites in Construction	