Graduate Program in Historic Preservation
Stuart Weitzman School of Design, University of Pennsylvania

HSPV 555 *Conservation Science*
George Wheeler, Ph.D., FAIA, FIIC, FAAR'97 Adjunct Professor

Course Syllabus Spring 2021

Lectures and Laboratories
Monday, 2:00-5:00

Communications

Office hours:	By appointment
Telephone:	By appointment
E-mail:	Subject heading of e-mails should state "HSPV 555"
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Research/Teaching Assistant:

Course Description
Conservation Science provides a fundmental understanding of architectural materials with respect to their composition, properties and performance and serves as the foundation for subsequent conservation courses such as HSPV738 – *Wood*, HSPV739 – *Masonry*, and HSPV740 – *Architectural Surface Finishes*, as well as, related courses such as HSPV551 – *Building Pathology* and HSPV552 – *Building Diagnostics and Monitoring*.

Beginning with a general discussion of mechanical properties such as strength, modulus, toughness, creep and fatigue of all architectural materials, the course moves to porous building materials such as stone, brick, terra cotta, mud brick, and concrete, cast stone and mortar and focuses on the evalution of their properties and their identification through an exploration of composition and texture in hand specimen and polarizing light microscopy. Rounding out the discussion of inorganic architectural materials is the examination of the unique set of properties of metals including their identification using methods of elemental analysis.

The course then shifts to the important organic architectural materials such as wood and finishes and begins with an overview of basic organic chemistry and follows with a more in-depth exploration of the properties and performance of wood, adhesives and clear finishes for wood, the chemistry of pigments and paint media, and, the identification pigments, paint media and clear finishes using several analytical methods.

Course Focus
HSPV 555 *Conservation Science* examines the fundamentals of the materials of architecture, including:

- Physical and mechanical properties
- Texture
- Composition
- Chemical properties
- Corrosion and deterioration

Course Format and General Responsibilities of Students
The format includes lectures, demonstrations, and laboratories. Students will be expected to carry out readings and view videos in preparation for class, complete exercises and assignments, attend all classes and participate in discussions, and complete verbal and written tests of knowledge. Assignments and some laboratory acitvities will occur outside of class time.

Learning Objectives
- Understand the primary properties of building materials, *i.e.* why and how are they used;
- Learn to recognize and name the general groups of buildings materials in hand specimen;
- Understand and be able to select and perform laboratory techniques and analytical methods of the identification of material type and assessment of material condition
- Learn to recognize and evaluate forms of loss of function and/or deterioration of building materials

Information Sources
Texts and in some cases instructional videos are provided for each class and are posted to the course website. Students are expected to read texts and view videos that support the learning objectives for each class.
Additional on-line databases that survey and abstract the conservation literature are:

The Bibliographic Database of the Conservation Information Network:
https://www.bcin.ca/home.app?lang=en
Art and Archaeology Technical Abstracts:
https://www.getty.edu/conservation/publications_resources/aata/index.html

While you are a student at the University of Pennsylvania you have free access to thousands of journal and databases. One of the most important for this course is the ASTM (American Society for Testing and Materials) database of standards and associated literature. You should take full advantage of this access during your time in the program.

Student Responsibilities
Students are expected to **attend all classes**, participate in discussions, and ask questions that assist in clarifying subject matter. Such engagement is carried out in a way that exhibits respect for all participants: professors, guests, and fellow students.

Readings are assigned to assist and deepen students' understanding of the concepts and ideas presented in class. These **readings are required**, and, on occasion, students will be queried on class as to their knowledge of the readings. Readings are posted to the course website.

Students are required to engage in **written and oral laboratory exercises** that support the overall learning objectives of the class and serve as a means to evaluate student performance.

Discussions between and among students is encouraged as a means to clarify and deepen understanding of the concepts and ideas presented in the class. However, with respect to assignments and written exercises, **students are responsible for their own work**.

Evaluation of Student Performance

- Preparation and Participation in Class 40%
- Oral and Written Assignments and Exercises 60%

At the instructor's discretion, grades will be adjusted for unexcused, late submission of assignments and exerises.

Class Schedule and General Description

25 January		
	Lecture	Mechanical properties of architectural materials with a focus on strength, modulus, ductility-malleability-brittlness, toughness, creep and fatigue
	Laboratory	4-point bend testing of brittle materials: stone, brick and mortar
1 February	Lecture	Properties and performance of porous building materials
	Laboratory	Capillary uptake, density (porosity and void space), ultrasonic velo
8 February	Lecture	Composition, texture and identification of porous building materials I: optical mineralogy and common building stones
	Laboratory	Fundamentals of optical mineralogy using polarizing light microscopy Hand specimen and polarizing light microscopy characterization and identification of common building stones
15 February	Lecture	Composition, texture and identification of porous building materials II: brick, terra cotta and adobe
	Laboratory	Hand specimen and polarizing light microscopy characterization and identification of brick, terra cotta and adobe
22 February	Lecture	Composition, texture and identification of porous building materials III: mortars and plasters
	Laboratory	Hand specimen, microchemistry and polarizing light microscopy characterization and identification of mortars and plasters
1 March	Lecture	Composition, texture and identification of porous building materials V: cast stone and concrete
	Laboratory	Hand specimen and polarizing light microscopy characterization and identification of cast stone and concrete
8 March	Lecture	Architectural metals I: sourcing and production of common metals and their alloys
	Laboratory	Densities and hand specimen identification 4-point bend testing of metal
	Readings	
15 March	Lecture	Architectural metals II: metal typologies, properties and performance
	Laboratory	Microchemical and XRF identification of metals

22 March	Lecture	General organic chemistry and the chemistry of paint media, adhesives, clear finishes and wood
29 March	Lecture	Architectural wood I: properties and performance of wood
	Laboratory	Densities and 3-point bend testing of wood
5 April	Lecture	Architectural wood II: Adhesives and clear finishes for wood
	Laboratory	Evaluation of the shear strength of adhesives
12 April	Lecture	The chemistry of paint media a
	Laboratory	Preparation and viewing of cross-sections in reflected light
19 April	Lecture	Pigments in architecture including analytical techniques Fundamentals of color measurement
	Laboratory	Microchemical testing, XRF and SEM-EDS analysis of pigments Color measurement via CIE-Lab and Munsell color space systems
26 April	Lecture	Paints and clear finishes in architecture including analytical techniques for media and clear finishes
	Laboratory	FTIR and Raman spectroscopies Reflected light microscopy including UV and staining techniques