GEORGIA INSTITUTE OF TECHNOLOGY
School of Civil and Environmental Engineering
CEE 6585/MSE 8803H Materials Science of Concrete
Course Syllabus
Spring 2020

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Course Objectives

- To integrate fundamental science-based concepts with engineering-based design and field performance of cement-based materials.
- To develop a more complete understanding of the relationships between materials selection and mixture proportioning and the multi-scale (nano → macro) structure behavior
- To build an awareness of the influence of composition and structure on early age behavior, mechanical property development, and long-term performance
- To develop an appreciation for both historical achievements and advancing technology related to the underlying science of cement and concrete use and behavior.
- To integrate research and learning.
- To improve critical thinking and written and oral technical communication skills.

Honor Code:
This course will be conducted under the guidelines of the Georgia Tech Academic Honor Code. A copy of the code can be found at https://policylibrary.gatech.edu/student-affairs/academic-honor-code

Course Requirements:
Grading will reflect performance on 2 exams and several assignments - 2 short technical reviews, 1 major critical review paper (with additional assignments for an outline for the review and presentation of the review), and critical reviews of 2 classmates' review papers - as well as class participation and several homework assignments:

HW #1	4%	February 24
Technical Review 1: Seminal paper in review topic	4%	February 10
Technical Review 2: Derivative paper in review topic	4%	February 17
Quiz #1 - Midterm Exam	20%	February 26
DETAILED review paper outline	8%	March 9
HW #2	4%	March 25
Review paper (In-depth **Critical** Review)	20%	April 6
Presentation of **Critical** Review	10%	April 8, 13, 15
Peer review of review papers (2)	4%	due by April 15
Quiz#2 - Final Exam	20%	April 24
Class participation/additional assignments	2%	Throughout semester

Required course materials:

Mehta, P.K. and Monteiro, P.J.M., CONCRETE: Microstructure, Properties, and Materials, 4th Edition, McGraw-Hill, 2014.

Additional electronically available materials:

Hewlett, P.C. and Liska, M. (Eds.) Lea's Chemistry of Cement and Concrete, Arnold, 5th Ed, 2019. (as PDF at GT library: https://www.sciencedirect.com/book/9780081007730/leas-chemistry-of-cement-and-concrete)

Scrivener, K.; Snellings, R. and Lothenbach, B. (Eds.) A Practical Guide to Microstructural Analysis of Cementitious Materials, CRC Press, 2016. (as PDF at GT library: https://www.taylorfrancis.com/books/e/9781351228497)

Ramachandran, V.S. and Beaudoin, J.J. (Eds.), Handbook of Analytical Technical in Concrete Science and Technology, William Andrew Publishing/Noyes Publications, 2001. (http://sci-lib.org/books_1/R/ramachandran.pdf)

Optional additional materials:

Kosmatka, S.H. and Wilson, M.L. Design and Control of Concrete Mixtures, PCA, 2016.

Taylor, H.F.W., Cement Chemistry, Thomas Telford, 1997.

Special Circumstances:

Notify the instructor *AS SOON AS POSSIBLE* if circumstances exist which require special coordination between the student and instructor for fulfillment of course objectives. Such circumstances may include absences during exams or lab periods or where tests are to be administered at ADAPTS. Notification which occurs *AFTER* the fact will result in a 0 for that assignment, laboratory, or exam.

Course Communications

- Information for the class will be posted by the instructors via the course website, accessed at https://gatech.instructure.com/courses/115582
- The official communication methods used by GT are Georgia Tech email and Canvas; you are responsible for checking your GT email account and the course web site on Canvas regularly; forwarding to other accounts is unreliable and not recommended.

Tentative Course Outline

Date	TOPICS COVERED	REQUIRED READING*	ADDITIONAL READING
1/6	Introduction to Cement and Concrete	Ch. 1	
1/8	History of Cement and Concrete	Ch. 1	Ch.1 Lea
1/8-13	Portland Cement Manufacture (Jin) - *Case Study: Caribbean cement manufacturing*	Ch. 6	Ch. 2-4,8 Lea
1/15	Portland Cement Characteristics & Specifications (Jin) - *Case Study: Type I vs. Type IL cements*	Ch. 6	Ch. 4 Lea
1/22	Portland Cement Hydration: Chemistry & Microstructure	Chs. 1-2	Diamond, *CCC*, (26):919-33.
1/27	Modeling of cement-based systems - **HW#1**	https://www.nist.gov/services-resources/software/vcctl-software	Bullard et al, *CCR*, 41:1209-23.
1/29-2/3	Supplementary Cementitious Materials and Blended Cements	Ch. 8	Chs. 9-11 Lea
2/5	Characterization of Cement-based Materials: Overview	--	Ramachanran and Beaudoin
2/10	**Technical Paper Review: In-Class Presentations of Seminal Papers**	Journal papers	--
2/12	Chemical Admixtures and Interactions (Jin) *Case Study: Addressing workability and shrinkage in MK-concrete with Admixtures*	Ch. 8	Ch. 14 Lea
2/17-2/24	Special Binder Systems, including Geopolymers (Lolli) *Case Study: Upscaling Alternative Cements for Next Generation Infrastructure*	Section 6.8	Juenger, *CCR*, 41(12):1232-43. Ch. 13,16 Lea
2/26	**QUIZ #1**		
3/2	Aggregates *Case Study: Recycled Concrete Aggregates*	Ch. 7	Ch. 15 Lea
3/4	ACI Mix Design – **HW#2** *Case Study: Design of Concrete for Mass Placement*	Ch. 9	Ch. 9, Kosmatka

			and Wilson
3/9	Alkali-aggregate reactions (AAR)	Sec 5.14	Ch. 7 Lea, Ch.12 Taylor
3/11	Concrete at Early Ages	Ch. 10	Ch. 5 Lea
--	NO CLASS MARCH 16, 18 (spring break)		
3/23	Dimensional Stability (Jin)	Ch. 4	Ch. 8 Lea
3/25	Hardened Concrete Properties (Jin)	Ch. 3	Ch. 7 Lea
3/30	Stress-Strain Relationships (Jin) *Case Study: Engineered Cementitious Composites*	Ch. 3	Ch. 7 Lea
4/1-6	Durability (Jin) *Case Study: Applications of Materials Science Principles in Assessing Field Performance*	Ch.5	Ch. 6 Lea, Ch.12 Taylor
4/8-15	**Critical Review Presentations (papers due April 6)**		
4/20	Concrete in the Future		Kurtis, *MRS Bulletin*, 40 (12): 1102-1109
Exam week	**QUIZ #2 – Friday, April 24, 2:40-5:30pm**		

* Required reading in Mehta and Monteiro