Syllabus

**CEE 504: Infrastructure NDT/NDE Techniques**

Department of Civil and Environmental Engineering, University of Illinois

***CANVAS LMS system***

**Term** Lecture: Monday, Wednesday, Friday 10:00am - 10:50pm

Lab sessions: AB1 Monday 3pm – 4:50pm and AB2 Wednesday 3pm-4:50pm

**Instructor** John S. Popovics

Office: 1116 NCEL; 244-0843; johnpop@illinois.edu, Office hours: by appointment

**Teaching assistant** Sangmin Lee

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**Course Objective:** To introduce the conceptual, theoretical and analytical tools necessary for inspection and evaluation of the concrete and steel infrastructure. Theoretical and practical information for a wide range of non-destructive testing (NDT) techniques will be given. The lectures are divided into three topic areas: **(*i*) theory background, (*ii*) fundamentals of NDE techniques and (*iii*) application of NDE.** Applications and limitations of the NDT techniques for bridges, pavements, deep foundations, and other structures will be illustrated. Laboratory sessions that involve application of NDE techniques complete the class. Another course objective is the development of effective technical communication skills through the term paper.

**Study Material** \* Reading material in course packet ***(Required, and made available to students electronically)***

\* Nondestructive Testing Handbook, Vol. 7: Ultrasonic Testing, American Society for Nondestructive Testing, Columbus, OH. ***(On reserve\*)***

\* In-place Methods to Estimate Concrete Strength, ACI Committee 228, Report ACI 228.1R-03. ***(On reserve\*)***

\* Nondestructive test methods for evaluation of concrete in structures, ACI Committee 228, Report ACI 228.2R-13. ***(On reserve\*)***

\* Non-destructive Evaluation: A Tool for Design, Manufacturing and Service, D.E. Bray and R.K. Stanley. McGraw Hill, 1989. ***(On reserve\*)***

\*CRC Handbook on Non-destructive Testing of Concrete, edited by N.J. Carino and V.M. Malhotra. CRC Press, 2003. ***(On reserve\*)***

\* http://www.ndt-ed.org/EducationResources/CommunityCollege/communitycollege.htm

##### Grading Weight Written assignments 15%

Task reports 15%

In-term exams (2@15%) 30%

Final exam 20%

Research project & presentation 20%

##### Course Policies

* + Reading assignments are assigned. These reading assignments will be made available electronically through the course Compass website
  + Academic integrity is expected; it is the responsibility of the student to refrain from such infractions as cheating, fabrication, and plagiarism in any aspect of the course. The definitions of, and university policies on, academic integrity are explained in Article 1, Part 4 of the Illinois student code (<http://admin.illinois.edu/policy/code/>).  Any assignment where plagiarism or other forms of cheating has been determined to occur will receive a score of zero. Any student who has been determined to plagiarize, cheat or fabricate more than once in this class during the course of the semester will receive a failing grade for the course. All questions of academic integrity will be handled through the established college of engineering procedure (FAIR system), which follows the student code. Please note the Illinois CEE honor code pledge: *I pledge to uphold the highest levels of professional and personal integrity in all of my actions, including 1) never assisting or receiving unfair assistance during exams, 2) never assisting or receiving assistance on class assignments beyond that specified by an instructor, and 3) always fully contributing to group activities that are part of a course activity*.
  + Each student is required to participate in a research project and present the findings to the class. The project includes handling and assessment of NDE data previously collected from a bridge deck. More detail on the project will be provided separately.
  + Laboratory sessions make up an important and required part of the course. As part of the laboratory sessions of the course, each student is required to participate in the sessions and present the findings in written assignments and reports. More detail on the laboratory sessions will be provided in a separate handout.

**CEE504 – Detailed lecture schedule**

**Date Lecture topic Reading**

Aug. 21 welcome and introduction

Theory background

Aug. 23 signal processing Assign. 1

Aug. 25 signal processing

Aug. 28 wave propagation Assign. 2

Aug. 30 wave propagation

Sept. 1wave propagation/ultrasound Assign. 7

***Sept. 4 Labor Day Holiday no class --------***

Sept. 6 ultrasound/dye penetrant Assigns. 6&7

Sept. 8 penetrating radiation Assign. 3

NDE techniques for steel structures

Sept. 11 radiography Assign. 8

Sept. 13 radiography and electromagnetism Assigns. 4,5& 8

Sept. 15 eddy current Assign. 9

Sept. 18 magnetic particle Assign. 10

Sept. 20 acoustic emission --------

Sept. 22 exam review --------

Sept**. 25 Exam 1** --------

NDE techniques for concrete structures and pavements

Sept. 27 visual inspection and surface rebound Assign. 11: sects. 1, 3.1; Assign 12

Sept. 29 UPV Assign. 11: sect. 3.2.1; Assign 13

Oct. 2 sounding and semi-destructive tests Assign. 12: sects. 2.3-2.5

Oct. 4 vibration methods --------

Oct. 6 impact-echo Assign. 11: sect. 3.2.3; Assign 14

Oct. 9 impact-echo Assign. 11: sect. 3.2.3; Assign 14

Oct. 11 magnetic and electrical methods Assign. 11: sect. 3.5; Assign 15

Oct. 13 electrochemical methods Assign. 11: sect. 3.5; Assign 15

Oct. 16SASW and MASW Assign. 11: sect.3.2.4; Assign 16

Oct. 18 multi-channel ultrasonic imaging Assign. 11: sect. 3.2.2

Oct. 20 GPR Assign. 17; Assign, 11: sect. 3.8

Oct. 23 GPR cont’d Assign. 17; Assign, 11: sect. 3.8

Oct. 25 deep foundations – sonic echo & impulse response Assign. 11: sect. 3.2.5 and 3.3

Oct. 27 thermography Assign. 18: Assign, 11: sect. 3.7

*Oct. 30 no class*

Nov. 1 nuclear and radiography Assign. 19; Assign, 11: sect. 3.4

Nov. 3 nuclear and radiography Assign. 19; Assign, 11: sect. 3.4

Nov. 6 Exam review --------

**Nov. 8 Exam 2** --------

Application of NDE

Nov. 10 concrete structures – in situ strength Assign. 12: sect. 4

Nov. 13 Planning NDE investigations Assign. 11: sect. 4

Nov. 15 NDE method application - steel --------

Nov. 17 NDE method application - concrete --------

***Nov. 18-26***  ***Thanksgiving holiday- no class***

Nov. 27 NDE method application - concrete--------

Nov. 29 guest lecturer: ?? @ WJE Associates--------

Dec. 1 ***student presentations*** --------

Dec. 4 ***student presentations*** --------

Dec. 6 Final exam review --------

**Dec. 14 Final exam @ 8-11am** --------

* + ***Physical Safety:*** emergency situations can arise at any moment, so it is best to be prepared for them. Please review the emergency planning information made available by the University Division of Public Safety at <https://police.illinois.edu/emergency-preparedness/run-hide-fight/>
  + ***Anti-racism and Inclusivity Statement:*** The Grainger College of Engineering is committed to the creation of an inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, disability status, class, or religious beliefs. The College recognizes Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community. The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (https://bart.illinois.edu/). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action