

WEST VIRGINIA UNIVERSITY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Course Title: **NONDESTRUCTIVE MATERIAL AND STRUCTURAL EVALUATIONS**
CE 564, Sec. 01
Fall Semester, 2018

Time and Place: Tuesday and Thursday, 9:30 - 10:45 A.M.
Room 501 ESB

Instructor: **Dr. Udaya B. Halabe**, Professor, CEE, Structures Group
Room 613 ESB, Phone: 304-293-9934, E-mail: udaya.halabe@mail.wvu.edu

Office Hours: Tuesday and Thursday, 11:00 A.M. - 12:00 Noon (or by appointment)

Course Objectives:

To study the various nondestructive testing (NDT) methods for evaluation and characterization of structures and materials, and the problems and issues related to NDT.

Course Description:

This course addresses the growing need for methods to detect in-situ material properties and degradation of structural components. Topics covered include different types of sensors, their functions, and underlying principles. A number of nondestructive techniques, drawn from the field of engineering, geophysics and remote sensing, will be presented. Emphasis will be placed on techniques based on infrared thermography, seismic and electromagnetic (radar) wave propagation, ultrasonics, acoustic emission, dynamic characterization, and electrical conductivity.

Applications to be considered include evaluation of building and bridge components (concrete, steel, wooden, and FRP components); high speed inspection of bridges and pavements; determination of soil properties and subsurface layer geometries; and detection of subsurface objects (e.g., steel reinforcement, underground pipes, buried drums, etc.). The course will include in-class and laboratory demonstrations of some of the nondestructive techniques currently being researched at WVU's College of Engineering and Mineral Resources.

Text Book:

A course package prepared by Dr. Halabe, which also includes a manual entitled, "Nondestructive Evaluation Methods for Highway Bridge Superstructures" by Halabe et al. (1995), will be made available to the students in PDF format. In addition, a number of handouts drawn from various sources will be provided to you in the class or by email throughout the semester.

References:

Students are strongly encouraged to read technical papers and articles published in NDT related journals, proceedings, books and magazines including papers/articles published in "Materials Evaluation," an official journal of the American Society for Nondestructive Testing (ASNT).

Course Outline:

- (1) Introduction
 - (a) Introduction to nondestructive testing
 - (b) Importance of nondestructive testing
 - (c) Various NDT methods in engineering
 - (d) Problems and issues related to measurement, data acquisition, and interpretation
- (2) Infrared Thermography
- (3) Geophysical and Ultrasonic Sensors (Geophones and Transducers)
- (4) Basic Concepts in Waveform Analysis
 - (a) Fourier series, Fourier transforms, convolution and deconvolution
 - (b) Reflection, transmission, and propagation of elastic waves
- (5) Seismic Methods Using Body, Surface, and Boundary Waves
- (6) Ultrasonics and Acoustic Emission
- (7) Dynamic Characterization
- (8) Electromagnetic Methods (Ground Penetrating Radar)
- (9) Project Presentation on Various Topics by Students

Course Materials:

All course materials, including lectures, class notes, quizzes, exams, handouts, presentations, and other materials provided to students for this course are protected intellectual property. As such, the unauthorized purchase or sale of these materials may result in disciplinary sanctions under the Campus Student Code.

<u>Grading:</u>	Class Attendance:	15% *
	Homework Assignments:	15%
	Term Project:	30%
	Comprehensive Exam:	40%

		100%

* Each **unexcused** absence will result in 0.5% reduction (i.e., your attendance grade will be **zero** if you miss 30 class lectures).

Final grades will be based on the following scale: 90% and above - A, between 80% and 90% - B, between 70% and 80% - C, between 60% and 70% - D, and below 60% - F. However, the instructor reserves the right to curve up (i.e., lower the grade cut-off boundaries and award higher grades than earned on this scale).

Notes:

- (1) Regular class attendance is required. Please let me know whenever you are unable to come to class. Taking notes in class is strongly suggested.
- (2) Homework assignments and the term project should be done individually. Students copying from each other will be given a score of zero. Late homework will not be accepted unless prior approval of the instructor is obtained.
- (3) There will be one comprehensive in-class exam towards the end of the course (on 12/4/2018).
- (4) The term project will be based on your research interests. Choose your own topics, but prior approval of the instructor will be required. Grade for the term project will be based on the final report and the presentation (see further details in Item # 7 below).
- (5) All submitted work should be neat, concise, clear and well organized, and should be presented on standard size paper (8.5" x 11"). No off-size papers will be accepted. Please staple all sheets together before submitting.
- (6) You are bound by the University Honor Code regarding Academic Honesty. It is your responsibility to know the code and the risks of violations (please see Graduate Catalog, available online at WVU Web Site).
- (7) **For the term project, each student must submit the following:**
 - (a) Tentative title and a brief description of your project - due on or before 8/28/2018.
 - (b) The final report (**hard copy and electronic - MS Word format**) - due on or before 10/30/2018 (late reports will be accepted only until 11/1/2018).
 - (c) Presentation of the projects (15 minutes each) will be held in class between 11/6/2018 and 11/15/2018.

Academic Integrity/Honesty:

You are bound by the university honor code; it is your responsibility to know the code and the risks of violations.

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at http://studentlife.wvu.edu/office_of_student_conduct/student_conduct_code. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me before the assignment is due to discuss the matter.

[adopted: 2-11-08]

Inclusivity Statement:

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Accessibility Services (304-293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see <http://diversity.wvu.edu/>

Days of Special Concern:

WVU recognizes the diversity of its students and the needs of those who wish to be absent from class to participate in Days of Special Concern, which are listed in the web site of WVU's Office of Social Justice. *Students should notify their instructors by the end of the second week of classes or prior to the first Day of Special Concern, whichever is earlier, regarding Day of Special Concern observances that will affect their attendance.* Further, students must abide by the attendance policy of their instructors as stated on their syllabi. Faculty will make reasonable accommodation for tests or field trips that a student misses as a result of observing a Day of Special Concern.

Adverse Weather Commitment:

In the event of inclement or threatening weather, everyone should use his or her best judgment regarding travel to and from campus. Safety should be the main concern. If you cannot get to class because of adverse weather conditions, you should contact me by email as soon as possible. Similarly, if I am unable to reach our class location, I will notify you of any cancellation or change as soon as possible (by 2 hours before class starts), using (MIX Email) to prevent you from embarking on any unnecessary travel. If you cannot get to class because of weather conditions, I will make allowances relative to required attendance policies, as well as any scheduled assignments.