

WEST VIRGINIA UNIVERSITY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Course Title: **NONDESTRUCTIVE MATERIAL AND STRUCTURAL EVALUATIONS**
CE 564, Sec. 01
Fall Semester, 2011

Time and Place: Tuesday and Thursday, 9:30 - 10:45 A.M.
Room 449 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, dynamic characterization, seismic and electromagnetic (radar) wave propagation, ultrasonics, acoustic emission, 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 **current** sources will be provided to you in the class throughout the semester.

References:

A list of NDT related references will be provided to you. 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

<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 grades 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 12/1/2011).
- (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, 2010-2012, pages 47-49).
- (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 9/6/2011
 - (b) The final report (**hard copy and electronic - MS Word format**) - due on or before 11/3/2011 (late reports will be accepted only until 11/8/2011)

Presentation of the projects (15 minutes each) will be held in class between 11/15/2011 and 12/6/2011.

Social Justice Statement:

West Virginia University is committed to social justice. I concur with that commitment and expect to foster a nurturing learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

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 Disability Services (304-293-6700).

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 Schedule of Courses. *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.

The following are the Days of Special Concern for this semester:

- **Eid-al-Fitr (End of Ramadan, Islamic) - August 30, 2011 (Tuesday)**
- **Rosh Hashanah (Jewish) - September 29, 2011 (Thursday)**
- **Yom Kippur (Jewish) - October 8, 2011 (Saturday)**
- **Veterans' Day - November 11, 2011 (Friday)**
- **Birth of Baha'u'llah (Baha'i) - November 12, 2011 (Saturday)**

Note: All Baha'i, Islamic, and Jewish observances begin at sundown the evening before the days stated above.