

Instructor: M. A. Gabr, Ph.D., P.E.

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Office Hours: MW 1.00 pm-3:00 pm, and,

On Zoom-Tuesday 3:00-5:00 pm; Zoom Link: <https://ncsu.zoom.us/j/91281338439>

Meeting ID: 912 8133 8439

One tap mobile: +14702509358,,91281338439# US (Atlanta)

Lecture Room: 02220 Engineering Building 3

Time: 11:45am-1:00pm M and W

Moodle: [Course: CE 741 \(001\) Fall 2022 Geomechanics of Stress Deformation \(ncsu.edu\)](#)

Students can view the Panopto recorded lectures at: [CE 741 : Panopto](#)

### **COURSE GOAL**

This course is designed to provide graduate students in civil engineering with advanced methods of analysis of various geotechnical systems with a focus on stress and deformation aspects. These include theories of elasticity and plasticity and applicability to soils, theories of consolidation, deformation tolerance, and response to static loading.

### **LEARNING OUTCOME**

The main objective of CE 741 is to introduce the subjects of stresses and deformation of soil media, theories of soil mechanics, and problems in elasticity and plasticity pertaining to earthwork. In this course, students will learn the following:

1. Fundamental Concepts of Effective Stress
2. Stress Distribution in Continuous Media
3. Elastic Displacements
4. Settlement Analysis
5. Aspects Related to Time-Dependent Settlement and Creep and tolerable deformation

At the end of this class, students are expected to understand the role and importance of idealized models versus real soil behavior and empirical procedures in Soil Mechanics. In addition, students will be able to apply porous elastic and elastic-plastic principles to represent the behavior of soils with an understanding of the associated limitations.

Several of the homework problems will expose the students to practical case studies related to deformation-based design approaches and specification of proper constitutive models for stress and deformation evaluation. This course will also provide the student with the opportunity to use simple computer program for the prediction of stresses and settlement in soil media.

### **TEXTS**

1. [CE 741 Lecture Notes](#),
2. T. W. Lambe and R. V. Whitman (1969) [Soil Mechanics](#), John Wiley & Sons, New York.
3. Young and B. P. Warkentin (1966) [Introduction to Soil Behavior](#), Macmillan, New York,
5. Robert D. Holtz, William D. Kovacs, and Thomas C. Sheahan, (2023) [An Introduction to Geotechnical Engineering](#), 3rd Edition, Pearson.

Supplementary material will be provided in the form of handouts.

### **SCHEDULE**

A tentative lecture schedule is attached as exhibit 1.

## ASSIGNMENTS

Several homework problems will be assigned throughout the semester. A semester long class project is also assigned with its components running in parallel to the covered course materials. A due date will be specified with each assignment. The submission of **all assignments** is required for a credit in this course. In addition to the assignments, you are required to study, present, and discuss a paper related to soil mechanics for its contribution to the subjects of stresses and deformation. Discussion/presentation may last from 15 to 20 minutes. Each student is also required to post five “current events” articles (or a link to an article) that are related to the topical coverage of the course material. The articles can be from publications found on the internet or trade magazines. At least two postings are required during the semester. A one paragraph summary is required with each posting.

### Paper Presentation Guidance

The presentation and discussion should not exceed 20 minutes.

- Generally, the presentation should cover essential background information: who the authors are, the paper's topic, methodology, and significant findings.
- Include details about the soil/material in question, analyses approach, model approach, set-up, and procedures. Discuss how these factors might have influenced the results.
- Analyze the results, trends, and limitations.
- Suggest future research directions.

Additionally, you're expected to challenge your colleagues with questions they can address during your presentation. A week before your discussion, direct your classmates to the selected paper via the discussion board. Lastly, by the semester's end, submit a two-page, one sided, single space summary focusing on results, trends, limitations, and potential future research areas. This summary will be considered an assignment.

*Engineering online students can make their presentation in class (if they are local and prefer to do so) or can electronically submit their presentation to be watched by all students.*

## COURSE GRADING

Mid Term Exam	30%
Final Exam	33%
Homework	12%
Paper Presentation and Summary	7%
Current Events	5%
Class Project	13%
TOTAL	<hr/> 100%

**Please Note:** Distance Engineering (DE) students should submit **exams** to the Engineering online office (EOL) per the stated deadline.

**Midterm and Final Exams are Open Book/ Open Notes**

## ACADEMIC INTEGRITY STATEMENT

Students are required to follow NCSU policy available at [www.ncsu.edu/provost/academic\\_regulations/integrity/reg.htm](http://www.ncsu.edu/provost/academic_regulations/integrity/reg.htm). "Academic dishonesty is the giving, taking, or presenting of information or material by a student that unethically or fraudulently aids oneself or another on any work which is to be considered in the determination of a grade or the completion of academic requirements or the enhancement of that student's record or academic career." (NCSU Code of Student Conduct). The Student Affairs web site has more information ([http://www.ncsu.edu/student\\_affairs/osc/AIpage/acaintegrity.html](http://www.ncsu.edu/student_affairs/osc/AIpage/acaintegrity.html)).

## **STUDENTS WITH DISABILITIES**

Reasonable accommodation will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with [Disability Services for Students](#) at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please see the [Academic Accommodations for Students with Disabilities Regulation](#).

### **Safe at NC State**

At NC State, we take the health and safety of students, faculty and staff seriously. The Office for Institutional Equity and Diversity supports the university community by providing services and resources to support and guide individuals in obtaining the help they need. See the Safe at NC State webpage for resources.

### **Exhibit 1. CE 741: Tentative Course Schedule**

#### *Tentative Schedule of Topics:*

<b>Dates</b>	<b>Topics</b>
Jan 08	I. Introduction and General Outline
Jan 10	Review of Soil Mechanics Basic Principles
Jan 15	MLK Day- No Class
Jan 17	A. Effective Stress B. Stresses at a Point
Jan 22	II. Stress Distribution in Continuous Media A. General Concepts
Jan 24	1. Field equations
Jan 29	2. Constitutive equations
Jan 31	3. Methods of solution
Feb 05	B. Solutions-Homogeneous Elastic Half-Space
Feb 07	1. Geostatic(body) forces 2. Surface loads a. Point loads b. Line loads c. Distributed loads
Feb 12	C. Other Elastic Solutions & Boundary Effects 1. Rigid base at finite depth
Feb 14	2. Layered elastic systems
Feb 19	3. Anisotropic materials
Feb 21	4. Non-homogeneous materials
Feb 26	5. Embankment loads 6. Excavations
Feb 28	III. Elastic Displacements A. General concepts B. Clays
Mar 04	C. Sands D. Typical Parameters
Mar 06	Mid Term Exam
Mar 11, 13	Spring Break
Mar 18	IV. Compressibility and Consolidation

Dates	Topics
Mar 20	A. Magnitude 1. Void ratio/strain-effective stress relations 2. Preconsolidation pressure 3. Three dimensional effect
Mar 25	B. Consolidation Time-Rate 1-D Derivation of time-rate of settlement
Mar 27	Continue
Apr 01	Radial Drainage
Apr 03	Continue
Apr 08	3. Secondary Compression a. Concepts and hypotheses b. Estimation methods
Apr 10	Preloads and Temporary Surcharge Loads 5. Time-Dependent Loading A. Magnitude of Settlement: Initial/Elastic
Apr 15	Continue
Apr 17	4. Special Methods a. Skempton-Bjerrum b. Stress Path
Apr 22	Differential Settlement and Damage
<b>Final Exam is scheduled on Friday April 26, 2024, 12:00 noon-2:30 pm</b>	