INSTRUCTOR

Dr. M. Shamim Rahman  
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Office Hours: T/Th 1:30-2:30

Class

Class Days: T & Th  
Time: 3:00 p.m. – 4:15 p.m.  
Classroom: Mann406

URL: http://courses.ncsu.edu/ce742/

COURSE GOAL

This course is designed to provide a theoretical framework for the analysis of deformation and failure of soils with application to several practical problems. These include elasticity for linear deformation, plasticity models (including critical state model) for non-linear deformation and limit equilibrium analyses for important geotechnical problems.

LEARNING OUTCOME

In this course, the students are expected to learn:

(i) Basic mechanics applied to soils  
(ii) Failure theory for soils and Shear Strength,  
(iii) Limit equilibrium analyses for (a) slope instability, (b) lateral earth pressure, and (c) bearing capacity of foundations.  
(iv) Elasticity for linear deformation of soils.  
(v) Theory of plasticity for the nonlinear deformation of soils,  
(vi) Critical state model for the deformation and strength of soils,  
(vii) Limit analyses for some geotechnical problems.

REFERENCE BOOKS

Recommended books for this course are:  

LECTURE NOTES

Partially completed Lecture Notes are also provided. Supplementary materials are provided in the form of handouts.

COMPUTER USE

The following computer programs/packages will be used:

1. SIGMA/W  
2. SLOPE/W

Additionally the students will to do some programming in MATLAB or EXCEL.
# COURSE ORGANIZATION AND SCOPE

<table>
<thead>
<tr>
<th>Lecture No. (75 minutes)</th>
<th>Topics</th>
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<tr>
<td>1</td>
<td><strong>I. Introduction</strong></td>
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| 2                        | **II. BASIC CONCEPTS FROM SOLID MECHANICS**  
  1. Stress and Stress Transformation, Stress Invariants |
| 3                        | 2. Total and effective Stresses in Soils, Equilibrium equation |
| 4                        | 3. Strains, Stress Transformation, Strain Compatibility, Constitutive Equation |
| 5                        | **III. SHEAR STRENGTH OF SOILS**  
  1. Mohr-Coulomb Failure Theory, Response of Soils to Shearing Force |
| 6                        | 2. A Simple Model to interpret Shear Strength, Drained and Un-drained Strength |
| 7                        | 3. Laboratory and Field Tests, Factors Affecting Shear Strength, Useful Correlations |
| 8                        | **IV. SLOPE INSTABILITY**  
  1. Introduction, Infinite Slope, Finite Slope |
| 9                        | 2. Stability analyses: General, Ordinary & Bishop’s Methods of slices |
| 10                       | 3. Spencer & Janbu Methods of Slope Stability Analysis, SLOPE/W |
| 11                       | 4. Wedge Method, Stability Charts, Time Dependent Changes in factor of Safety |
| 12                       | **V. LATERAL EARTH PRESSURE**  
  1. Introduction, Geostatic Lateral Pressure, Active and Passive Lateral Pressure Rankine’s – Rankine’s Theory |
| 13                       | 2. Coulomb’s Force Analyses for Lateral earth Pressure |
| 14                       | 3. Log Spiral Slip Surface |
| 15                       | **VI. BEARING CAPACITY OF SHALLOW FOUNDATIONS**  
  1. Introduction, Simple Limit Equilibrium Analyses |
| 16                       | 2. Log Spiral Slip Surface – Bearing Capacity Equation |
| 17                       | 3. General Bearing Capacity Equation |
| 18                       | **VII. THEORY OF ELASTICITY**  
  1. Stress-Strain Relationship for various loading conditions |
| 19                       | 2. Elastic Stress Analysis, Introduction to Computer Program SIGMAW |
| 20                       | **VIII. THEORY OF PLASTICITY AND MODELS FOR SOILS**  
  1. Elements of Plasticity, Yield Criteria ( Mohr-Coulomb, Drucker-Prager) |
| 21                       | 2. Post-yield Behavior, Flow Rule, Incremental Stress-Strain Relationship |
| 22                       | 3. Elastic-Perfectly Plastic Model |
| 23                       | 4. Hardening Plasticity Based Model |
| 24                       | **IX. CRITICAL STATE MODEL (CSM)**  
  1. Elements of CSM |
| 25                       | 2. Prediction of Yield and Failure Stresses |
| 26                       | 3. Prediction of Stress-Strain Relationship |
| 27                       | **X. LIMIT ANALYSES**  
  1. Elements of Limit Analysis, Lower and Upper Bound Theorems |
| 28                       | 2. Evaluation of Lower and Upper Bounds for some Geotechnical Problems |
| 29                       | **REVIEW & CLOSURE** |
COURSE REQUIREMENTS

The course requirements include regular assignments, one final exam, and a term project (with presentation) on a topic of your interest compatible with the general theme of the course.

HOMEWORK

Homework will be assigned to help you understand the material. You are encouraged to provide neat, well thought-out write-ups or the assignments. Incomplete, messy and difficult to follow solutions will be penalized. Email: Send homework as an attachment to homework_eol@ncsu.edu [Fax: 919.515.8415] -- Tell them to make a copy of the homework and then send the copy via fax to me (919 515 7908).

PROJECT

A term project is also required. The topics chosen by the students in consultation with the instructor are intimately related to the general theme of deformation and failure of soils developed in this course. The students are required to make an oral presentation and then to submit a written report.

COURSE GRADING

The following weights will be assigned:

1. Assignments 25%
2. Take Home Tests(2) 50%
3. Term Project/Paper 25%

Grading Scale (may be curved upward at option of instructor):

- A-/A/A+ 90.0-100.0
- B-/B/B+ 80.0-89.9
- C-/C/C+ 70.0-79.9
- D-/D/D+ 60.0-69.9
- F <60.0

COURSE POLICIES AND PROCEDURES

1. There will be one exam during the semester and one final exam. If a student misses his/her final exam without a valid excuse, a zero will be averaged into his/her grade. See http://www.ncsu.edu/policies/academic_affairs/pols_regs/REG205.00.4.php for a detailed description of the University’s attendance regulations.
2. Homework will be due at the beginning of the class period on the assigned due date.

PREREQUISITES, COREQUISITES

Graduate standing in Civil Engineering, CE 443 “Seepage, Earth Embankments and Retaining Structures” or CE 440 “Foundation Engineering” or CE 548 “Engineering Properties of Soils I” or equivalent, or permission of instructor.

ACADEMIC INTEGRITY STATEMENT

Students are expected to adhere to the guidelines for academic integrity as outlined in the NC State University Code of Student Conduct (http://www.fis.ncsu.edu/ncsulegal/41.03-codeof.htm). Cheating and plagiarism will result in loss of credit for the test or assignment in question.

STUDENTS WITH DISABILITIES

“Reasonable accommodations 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 (REG02.20.1)”