

Geotechnical Engineering Thrust Area (2020-21)

Civil Engineering ATE (Approved Technical Elective) Advising Sheet

Each CE student is required to take 24 units of ATE (Approved Technical Electives). These electives can be any CE/ENVE 400/500 level coursework (not required as part of the major), some CE/ENVE 300 level course work, or any one of a list of preapproved elective options from outside CE/ENVE (check the department website). This freedom in the CE program allows students to specialize in a particular area (or two or three...) or develop a little deeper in all areas. Please consider your choices in the context of graduate school, the area in which you would like to practice, or the breadth of knowledge you would like to attain. Below is the **Thrust Area** for Geotechnical Engineering to consider as you plan your Senior Year. **NOTE:** You may mix and match ATE's in any way you like that works best for you, your schedule, and we encourage you to seek faculty advising to help map your final choices.

Students interested in geotechnical engineering should consider CE 481 as part of their base ATE study plan. For the remaining 20 units, complementary courses include: CE 488, CE 434, CE 486, 400-level civil engineering courses in structures, approved technical elective ERSC/GEOL courses, and approved technical elective BRAE surveying courses. Graduate level CE 58X courses in geotechnical engineering offer the opportunity to gain depth in a particular design area (e.g., slopes, walls, foundations, earthquakes, environmental geotechnics, etc.). However, we recommend a student consider only one or a maximum of two graduate-level geotechnical courses when putting together his/her study plan. Approved technical elective (ATE) breadth in foundation design, geology, surveying, risk analysis, engineering geology, groundwater hydraulics, and structures will prepare civil engineering undergraduates to be successful in geotechnical engineering, if their post-undergraduate goals include engineering practice or graduate school. **Courses in the GE Thrust Area require prior completion of CE381 and CE382.**

	Fall	Winter	Spring
Choose <u>all</u> from this group:			
ATE Base Course	CE 481 (4) - Analysis and Design of Shallow Foundations (Course offered FWS but required prerequisite to 500 level WS courses)		
Complementary Courses	CE 488 (4) - Engineering Risk Analysis	CE 486 (4) - Introduction to Geologic Engineering	
		CE 434 (4) - Groundwater Hydraulics and Hydrology (Course offered Winter and Spring)	
Consider <u>at least</u> one of the following:			
Complementary Courses in Structures	CE 356 (4) - Structural Steel Design (Course offered Fall and Spring - NOT Winter)		
	CE 406 (4) - Structural Analysis	CE 407 (4) - Structural Dynamics (CE 406 is a prerequisite)	CE 457 (4) - Bridge Engineering
Outside Civil Engineering Recommendations ²	GEOL 415 ^{2,3} (4) - Structural Geology	GEOL 401 ^{2,3} (4) - Field-Geology Methods	BRAE 447 ^{2,3} (4) - Advanced Surveying with GIS Applications
	GEOL 420 ^{2,3} (4) - Applied Geophysics		
500 Level Options	Choose <u>NO MORE</u> than two of the following Graduate Level Courses:		
	CE 584 ¹ (4) - Slope Stability	CE 586 ¹ (4) - Analysis and Design of Deep Foundations	CE 581 ¹ (4) - Advanced Geotechnical Engineering
			CE 583 ¹ (4) - Geotechnical Earthquake Engineering
			CE 587 ¹ (4) - Geoenvironmental Engineering

1. CE 481 Required Prerequisite
2. Approval required to take both courses exceeding 4 units outside the major
3. See instructor for permission number and prerequisite waiver

BRAE 447. Advanced Surveying with GIS Applications. 4 units - Prerequisite: BRAE 239.

Collecting field data; processing the data; generating graphical representation of the data; design based on the data and laying out the design in the field; and available record resources for use in GIS systems and their accuracy. 2 lectures, 2 laboratories.

CE 356. Structural Steel Design. 4 units - Prerequisite: CE 352.

Design and behavior of the elements of steel structures. Design and analysis of bolted, welded and eccentric connections. Proportioning of members and connections. Introduction to plastic design, end plate connection, composite construction, shear connections and design of composite beams. 3 lectures, 1 laboratory.

CE 406. Structural Analysis. 5 units - Prerequisite: CE 352.

Structural analysis of frames, trusses, and combined systems. Modern structural analysis theorems are presented along with discussion of their relation to classical methods. Specific topics include virtual forces, virtual displacements, compatibility, constraints and matrix formulations. Course may be offered in classroom-based or online format. 4 lectures, 1 laboratory.

CE 407. Structural Dynamics. 4 units - Prerequisite: CE 406 and ME 212.

Effect of vibration and transient loads on structural elements. Dynamics load factors, support motion, damping and natural frequencies of multidimensional structural systems. Modal analysis. 3 lectures, 1 laboratory.

CE 434. Groundwater Hydraulics and Hydrology. 4 units - Prerequisite: CE 336.

Differential equations of groundwater flow, Darcy's Law, solutions of the steady and unsteady flow, differential equations for confined and unconfined flows. Pumping test design. Groundwater models, leaky aquifers. Saltwater intrusion. 4 lectures.

CE 457. Bridge Engineering. 4 units - Prerequisite: CE 355.

Fundamentals of the structural analysis and design of highway bridges. Construction materials in bridges. Loads on highway bridges. Load path and distribution in bridge superstructure. Design of reinforced concrete, pre-stressed concrete, and composite bridges. 3 lectures, 1 laboratory.

CE 481. Analysis and Design of Shallow Foundations. 4 units - Prerequisite: CE 381 and CE 382.

Evaluation of shear strength for foundation design. Analysis of bearing capacity for generalized conditions. Design of reinforced concrete spread footings. Stress distributions beneath loaded areas. Immediate settlement, consolidation settlement, rate of consolidation, and creep. 4 lectures.

CE 488. Engineering Risk Analysis. 4 units - Prerequisite: CE 381 and STAT 312.

Introduction to the basic concepts of probability theory, statistics, and decision theory as they pertain to problems in civil and environmental engineering. Emphasis placed on the use of probabilistic modeling, Bayesian statistics, risk analysis, and decision theory. 4 lectures.

CE 581. Advanced Geotechnical Engineering. 4 units - Prerequisite: CE 481 or graduate standing.

Advanced topics in saturated flow, unsaturated flow, and consolidation. Stress-strain-deformation response of soils under both drained and undrained loading. Conventional and advanced laboratory strength testing. 3 lectures, 1 laboratory.

CE 583. Geotechnical Earthquake Engineering. 4 units - Prerequisite: CE 481 or graduate standing.

Introduction to engineering seismology and ground motion evaluation. Dynamic behavior of soils. Seismic site response analysis. Soil liquefaction evaluation methods and mitigation techniques. Seismic stability of slopes and retaining walls. Computer-aided analysis. 4 lectures.

CE 585. Slope Stability Analysis. 4 units - Prerequisite: CE 481 or graduate standing.

Analysis of stability by planar, circular arc, piecewise-linear, and composite-surface techniques. Analysis of earth-fill dams and reservoirs for static, steady flow, sudden drawdown, and seismic loading conditions. Field instrumentation. Methods for slope remediation and stabilization. Computer-aided analysis. 4 lectures.

CE 586. Analysis and Design of Deep Foundations. 4 units - Prerequisite: CE 481 or graduate standing.

Bearing capacity and settlement analysis of drilled shafts and driven piles. Analysis and design of single piles and pile groups for vertical, lateral, and combined loading. Construction procedures, field inspection, and load-testing. Computer-aided analysis and design. 4 lectures.

CE 587. Geoenvironmental Engineering. 4 units - Prerequisite: CE 381 or graduate standing.

Principles for containment applications. Engineering properties of soils and geosynthetics and their interaction with contaminants and wastes; analysis of geosynthetics used in containment facilities; liners; covers; leachate and gas collection systems; contaminant transport; and monitoring systems. 4 lectures.

GEOL 401. Field-Geology Method. 4 units - Prerequisite: GEOL 201 or ERSC 223.

Collecting and interpreting field-geologic data. Description of sedimentary rocks and construction of stratigraphic columns. Mapping geologic structures in the field. Surficial geologic stratigraphy and surficial geologic mapping. Understanding geologic processes through field study. Communicating results of field study. 1 lecture, 3 activities. Crosslisted as ERSC/GEOL 401.

GEOL 415. Structural Geology. 4 units - Prerequisite: GEOL 241, ERSC 223.

Recognition, interpretation, and depiction of geological structures. Understanding rock deformation through the study of faults and folds. 3 lectures, 1 laboratory. Required weekend field trips.

GEOL 420. Applied Geophysics. 4 units - Prerequisite: GEOL 201, PHYS 141.

Introduction to geophysical exploration of the shallow subsurface: seismic refraction, seismic reflection, electrical resistivity, magnetic and gravity methods. Application to determination of subsurface structure, groundwater and mineral resources. Field trip required. 2 lectures, 1 laboratory.