

# CIVIL ENGINEERING (CE)

## College of Engineering and Mines

Department of Civil, Geological and Environmental Engineering (<https://www.uaf.edu/cem/programs/civil-engineering/>)  
907-474-7241

### CE F112 Elementary Surveying

3 Credits

Offered Fall

Basic plane surveying; use of transit, level, theodolite and total station. Traverses, public land system, circular curves, cross-sectioning and earthwork.

**Prerequisites:** MATH F152X.

**Lecture + Lab + Other:** 2 + 3 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CE F302 Fundamentals of Transportation Engineering

3 Credits

Offered Spring

Introduction to multimodal transportation systems and the factors that influence the planning, design and operation of transportation systems. Highway systems are emphasized, with keen focus on issues related to Northern climates.

**Prerequisites:** CE F112 or MIN F202; sophomore standing.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CE F326 Introduction to Geotechnical Engineering and Foundations

4 Credits

Offered Fall

Identification and classification of soils; physical and mechanical properties of soil; subsurface exploration; movement of water through soil; soil deformation. Bearing capacity of shallow foundations and piles, and stability of retaining walls. Laboratory testing techniques, and introduction to soil issues related to cold regions.

**Prerequisites:** ES F331 (may be taken concurrently); GE F261.

**Crosslisted with** GE F326.

**Lecture + Lab + Other:** 3 + 3 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CE F331 Structural Analysis

3 Credits

Offered Spring

Introduces techniques for the analysis of statically determinate and indeterminate structures to include beams, trusses and frames. Reviews internal force resultants, shear and moment diagrams, deflections, internal stresses. Discusses indeterminate analysis of structures, including methods of consistent deflections and slope-deflection. Provides an introduction to matrix methods.

**Prerequisites:** ES F208; ES F331.

**Lecture + Lab + Other:** 2 + 0 + 3

**Grading System:** Letter Grades with option of Plus/Minus

### CE F334 Properties of Materials

3 Credits

Offered Spring

Properties of engineering materials. Bonding, crystal and amorphous structures. Relationships between microstructure and engineering properties. Modification of properties and environmental serviceability. Concrete and asphalt mixes.

**Prerequisites:** ES F331; may be taken concurrently.

**Lecture + Lab + Other:** 2 + 3 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CE F341 Introduction to Environmental Engineering

4 Credits

Offered Fall

Introduces fundamentals of environmental engineering theory and application including topics in water chemistry, mass balance, heat transfer, water/wastewater quality and treatment, air quality engineering, and design of natural/engineered processes for contaminant removal. Laboratory activities supplement lecture material and provide an introduction to statistical analyses, data interpretation and preparation of reports.

**Prerequisites:** CHEM F106X; or graduate standing.

**Lecture + Lab + Other:** 3 + 3 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CE F344 Water Resources Engineering

3 Credits

Offered Fall

Fundamentals of engineering hydrology and hydraulic engineering. Water cycle and water balance, precipitation, evaporation, runoff, statistical methods, flood control, open channels and groundwater.

**Prerequisites:** ES F341.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CE F401 Arctic Engineering

3 Credits

Offered Fall

Introduces students to a broad spectrum of engineering challenges unique to cold regions. Discusses physical principles and practical data collection methods, analyses, designs and construction methods. Students gain a working knowledge of cold regions engineering problems and modern solutions as a basis for more detailed study.

**Prerequisites:** Senior standing in engineering or a BS in engineering.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CE F405 Design of Highways and Streets

3 Credits

Offered Fall Even-numbered Years

Design and analysis of streets and highways with an emphasis on safety and efficiency. Design topics include: surveys, vertical and horizontal alignments, cross sections, and gravel roads. Analysis topics include: flow and gap acceptance theory, impact and safety analysis, signal timing and coordination.

**Prerequisite:** CE F302.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CE F408 Transportation Safety Analysis**

3 Credits

Offered Fall Odd-numbered Years

Analysis of streets and highways with an emphasis on safety. Analysis of alternatives and control strategies with respect to crash probabilities. Statistical models for safety analysis; crash data collection, database management and data analysis; safety improvement programs; statistical modeling; and before-and-after studies.

**Prerequisites:** CE F302.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F412 Elements Photogrammetry**

3 Credits

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**Lecture + Lab + Other:** 0 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F420 Groundwater Engineering**

3 Credits

Offered Fall

Fundamentals of groundwater occurrence, hydrology, resource development, water quality, monitoring and remediation. Field methods and modeling.

**Prerequisites:** CE F326, GE F326; ES F341.**Crosslisted with** GE F420.**Lecture + Lab + Other:** 2 + 3 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F422 Foundation Engineering**

3 Credits

Offered Fall

Reviews slope stability analysis. Introduces bearing capacity of soils and effects of settlements on structure; discusses design of footings and rafts, pile and pier foundations, retaining walls and anchored bulkheads, foundations on frozen soils, and construction problems in foundation engineering.

**Prerequisites:** CE F326; ES F301.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F424 Permafrost Engineering**

3 Credits

Offered Spring

Permafrost and frozen ground engineering, types of permafrost and ways of its formations, factors important for permafrost existence, hazards related to permafrost, index, thermal, and mechanical properties of frozen and thawing soils, thermal analysis methods of soil freezing and thawing, foundations design alternatives, pipelines, roads and airfields in permafrost regions.

**Prerequisites:** CE F326.**Recommended:** CE F422.**Stacked with** CE F624.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F432 Steel Design**

3 Credits

Offered Fall

Introduces structural design philosophies and current practices related to steel design. Utilizes the AISC Specification to discuss the design of basic structural elements in steel including tension members, fasteners, welds, column buckling, beam behavior, beam-columns, and composite floor systems.

**Prerequisites:** CE F331; ES F331.**Lecture + Lab + Other:** 2 + 3 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F433 Reinforced Concrete Design**

3 Credits

Offered Spring

Introduces structural design philosophies and current practices related to reinforced concrete design. Utilizes the ACI 318 Specification to discuss the behavior of reinforced concrete members and their design including flexural members, such as rectangular, T-beams, one-way slabs, and axial members. Crack control, anchorage, development lengths and deflections are covered.

**Prerequisites:** CE F331; ES F331.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F434 Timber Design**

3 Credits

Offered Fall

Design loads. Building systems and loading path. Physical and mechanical properties of wood. Design values and adjustment factors. Design of axial members, beams and columns. Connection details. Design of wood frame structures. Current National Design Specifications (NDS) for Wood Construction used.

**Prerequisites:** CE F331; ES F331.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F438 Design of Engineered Systems**

3 Credits

Offered Spring

Capstone design experience where students demonstrate understanding of system design principles using service learning projects with civil and environmental engineering focus. Practical applications of fundamental engineering concepts such as codes and standards, ethics and safety, and liability and legal principles. Emphasis on teamwork, leadership and oral communication with diverse audiences.

**Prerequisites:** Civil engineering major with senior standing; COM F131X or COM F141X; WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; A minimum of two upper-division CE design courses, such as CE F405, CE F408, CE F422, CE F432, CE F433, CE F434, CE F442 or CE F445.

**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F442 Water and Wastewater Treatment Design**

3 Credits

Offered Spring

Presents design methods for pollution control and remediation in water systems. Applies theories and engineering principles for the design of physical, chemical, and biological processes for the treatment of water and wastewater.

**Prerequisites:** CE F341, CHEM F106X or graduate standing.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus

**CE F443 Air Pollution Management**

3 Credits

Offered Spring Odd-numbered Years

Major principles and problems associated with air quality, stationary and moving sources, air pollution effects; major air pollution legislation and compliance calculations; meteorology and modeling of pollutant concentrations near a source; greenhouse gas emissions and climate change; control equipment and design of control strategies for specific air pollution problems.

**Prerequisites:** CHEM F106X; graduate standing.**Recommended:** MATH F252X.**Stacked with** ENVE F643.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F445 Hydrologic Analysis and Design**

3 Credits

Offered Spring

Design and analysis; extended coverage of hydrologic concepts from CE F344. Precipitation, snow cover and evaporation analysis; groundwater hydraulics; runoff analysis and prediction; statistical hydrology; application of simulation models. Design of structures such as culverts, reservoirs, wells, pumps and pipe networks.

**Prerequisites:** CE F344.**Lecture + Lab + Other:** 2 + 3 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F451 Construction Cost Estimating and Bid Preparation**

3 Credits

Offered Fall

Compilation and analysis of the many items that influence and contribute to the cost of projects to be constructed. Preparation of cost proposals and study of bidding procedures.

**Recommended:** College math.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F601 Engineering Research Communication**

3 Credits

Offered As Demand Warrants

Oral and written communication techniques to describe results on current issues in environmental science and engineering.

**Prerequisites:** Graduate Standing.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F605 Pavement Design**

3 Credits

Offered As Demand Warrants

Provides instruction on the current practices of analysis and design of highway and airport pavements. The instruction includes theoretical and practical approaches for the design of flexible and rigid pavements. Materials characterization, load considerations, empirical and mechanistic design methods as well as rehabilitation are covered.

**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F607 GIS Applications in Civil Engineering**

3 Credits

Offered As Demand Warrants

Theories and advanced methods of Geographic Information Systems for civil engineering practice. Students will apply and execute concepts related to data integration, analysis and management in the ArcGIS suite during labs.

**Prerequisites:** Graduate standing in CE.**Lecture + Lab + Other:** 2 + 3 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F620 Construction Project Management**

3 Credits

Offered As Demand Warrants

Construction equipment, methods, planning and scheduling, construction contracts, management and accounting, construction estimates, costs, and project control.

**Recommended:** ESM F450 or equivalent.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F622 Foundations and Retaining Structures**

3 Credits

Offered As Demand Warrants

Advanced study of shallow and deep foundations; analyses and design of retaining walls, free-standing sheet-pile walls, braced excavations, slurry walls, tied-back retention systems, reinforced earth, frozen soil walls, anchored bulkheads, and cellular cofferdams.

**Prerequisites:** CE F422.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F624 Permafrost Engineering**

3 Credits

Offered Spring

Permafrost and frozen ground engineering, types of permafrost and ways of its formations, factors important for permafrost existence, hazards related to permafrost, index, thermal, and mechanical properties of frozen and thawing soils, thermal analysis methods of soil freezing and thawing, foundations design alternatives, pipelines, roads and airfields in permafrost regions.

**Prerequisites:** Training or experience in soil mechanics.**Stacked with** CE F424.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F625 Soil Stabilization and Embankment Design**

3 Credits

Offered As Demand Warrants

Soil and site improvement using deep and shallow compaction, additives, pre-loading, vertical and horizontal drains, electro-osmosis and soil reinforcement, dewatering and stabilization; embankment design, earth pressure theories and pressure in embankment, embankment stability, embankment construction, control and instrumentation.

**Prerequisites:** CE F422.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus

**CE F626 Thermal Geotechnics**

3 Credits

Offered As Demand Warrants

Fundamentals of thermal regimes of soils and rocks. Thermal impact of structures on soils. Thawing of permafrost beneath roads, buildings and around pipelines. Natural and artificial freezing of soils. Engineering means to maintain thermal regime of soils. Thermal design considerations.

**Prerequisites:** CE F326; CE F422.**Cross-listed with** GE F626.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F627 Geotechnical Earthquake Engineering**

3 Credits

Offered As Demand Warrants

Introduction to soil dynamics and geotechnical aspects of earthquakes; influences of soils on ground motion, determination of soil response under strong seismic motion, causes of soil failures, soil liquefaction, lateral spreading, the seismic response of earth structures, and seismic-deformation procedures for slopes.

**Prerequisites:** CE F326.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F628 Unsaturated Soils Mechanics**

3 Credits

Offered As Demand Warrants

Fundamentals of soil behavior under load; pore pressure during monotonic loading; Ladd's "Simple Clay" model; densification and drained cyclic loading of sand; undrained cycle loading of soil.

**Prerequisites:** CE F326.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F630 Advanced Structural Mechanics**

3 Credits

Offered As Demand Warrants

Shear and torsion, nonsymmetrical bending, shear center, curved beams, introduction to composite material mechanics, application in bridge engineering.

**Prerequisites:** MATH F302; ES F331.**Recommended:** Graduate standing in engineering.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F631 Advanced Structural Analysis**

3 Credits

Offered As Demand Warrants

Derivation of the basic equations governing linear structural systems. Application of stiffness and flexibility methods to trusses and frames. Solution techniques utilizing digital computers. Planar structures and space structures (trusses and frames) will be covered. Both exact and approximate solution techniques will be reviewed.

**Prerequisites:** CE F331.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F633 Theory of Elastic Stability**

3 Credits

Offered As Demand Warrants

The theories of elastic and inelastic buckling are studied with practical implementation to slender structural members. Both lateral and local buckling concepts will be examined. Lateral torsional buckling of beams; buckling of beam-columns and frame members; and buckling of members with various cross-section shapes are extensively discussed.

**Prerequisites:** CE F331; CE F432; MATH F302.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F634 Structural Dynamics**

3 Credits

Offered As Demand Warrants

The theories of structural dynamics are studied with an emphasis on analysis and design of civil engineering structures under various dynamic loading. Topics include single and multiple degree-of-freedom systems subjected to free vibration, harmonic excitations and earthquakes. The basic concepts related to seismic design of structures will be discussed.

**Prerequisites:** ES F208, ES F210; CE F331; MATH F302.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F635 Numerical Methods for Geomechanics and Soil-Structure Interaction**

3 Credits

Offered As Demand Warrants

Applications of numerical methods for problems involving seepage, consolidation, foundation on expansive soils and pile installation. Finite difference and element methods, non-linear analysis techniques, elastoplastic formulation with a tangent stiffness approach, seepage analysis, flow-deformation, coupled analysis, models for soil-structure interaction, solution accuracy and reliability.

**Prerequisites:** CE F326; graduate standing.**Recommended:** MATH F302.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F637 Earthquakes: Seismic Response of Structures**

3 Credits

Offered As Demand Warrants

Fundamentals of structural earthquake engineering are provided. Topics include earthquake engineering; current seismic design criteria and practice; structural analysis for seismic load; design of lateral force resisting systems such as moment frames, braced frames and shear walls; design of diaphragms; and design of non-structural components.

**Prerequisites:** ES F208, ES F210.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F640 Prestressed Concrete**

3 Credits

Offered As Demand Warrants

Theory and practice of prestressed concrete design. Pre-tensioning and post-tensioning. Anchorage of steel. Materials, design specifications. Application in bridges, tanks and slabs.

**Prerequisites:** CE F331; CE F433.**Recommended:** Graduate standing.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus

**CE F646 Structural Composites**

3 Credits

Offered As Demand Warrants

The basics of structural composite theory. Basic design procedures related to structural composite members and the structural analysis of members made of various materials to create laminates or sandwich panels will be covered.

**Prerequisites:** ES F331; CE F331.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F650 Bridge Engineering**

3 Credits

Offered As Demand Warrants

Covers structural systems, loading and analysis by influence lines. Slab and girder bridges considering composite design, prestressed and concrete bridges and how these bridges are designed and rated using AASHTO specifications.

**Prerequisites:** CE F432; CE F433.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F661 Advanced Water Resources Engineering**

3 Credits

Offered Spring Odd-numbered Years

Engineering hydraulics and hydrology including use of standard computer models to solve water resource engineering problems.

**Recommended:** Permission of instructor.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F662 Open Channel and River Engineering**

3 Credits

Offered Spring Even-numbered Years

Principles of open channel flow, specific energy, hydraulic jump, transitions and controls, uniform and non-uniform flows, steady and unsteady flows, numerical solution for unsteady flows. River engineering, stream channel mechanics, and mechanics of sedimentation.

**Recommended:** Permission of instructor.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F663 Groundwater Hydrology**

3 Credits

Offered Fall Even-numbered Years

Fundamentals of groundwater aquifer formations, groundwater flow, resource development, management and protection.

**Cross-listed with** GE F663.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F664 Sediment Transport**

3 Credits

Offered Spring Even-numbered Years

Fundamentals of sediment transport processes in rivers, oceans and reservoirs. Bed-load and suspended-load transports. Mechanics of turbidity currents. Reservoir sedimentation. Numerical modeling.

**Prerequisites:** Graduate standing.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F665 Watershed Hydrology**

3 Credits

Offered As Demand Warrants

A broad view of the water cycle at the watershed scale and introduction to the quantitative relations between components of the water cycle. Emphasis is placed on precipitation, evapotranspiration, water in soils and stream response to water-input events.

**Prerequisites:** MATH F253X; PHYS F211X.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F682 Ice Engineering**

3 Credits

Offered As Demand Warrants

The factors governing design of marine structures, which must contend with the presence of ice. Topics include ice growth, ice structure, mechanical properties and their dependence on temperature and structure, creep and fracture, mechanics of ice sheets, forces on structures, and experimental methods.

**Prerequisites:** ES F331, MATH F253X, training or experience in soil mechanics.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F683 Arctic Hydrology and Hydraulic Engineering**

3 Credits

Offered As Demand Warrants

Aspects of hydrology and hydraulics unique to engineering problems of the north. Although the emphasis will be on Alaskan conditions, information from Canada and other circumpolar countries will be included in the course.

**Prerequisites:** CE F344.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F684 Arctic Utility Distribution**

3 Credits

Offered As Demand Warrants

Practices and considerations of utility distribution in Arctic regions. Emphasis on proper design to include freeze protection, materials, energy conservation and system selection.

**Prerequisites:** ES F341.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F685 Topics in Frozen Ground Engineering**

3 Credits

Offered As Demand Warrants

Selected frozen ground foundation engineering problems will be explored in depth including refrigerated foundations and pile foundations.

**Prerequisites:** CE F424 or CE F624.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CE F692 Seminar**

1-3 Credits

**Lecture + Lab + Other:** 0 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**Repeatable for Credit:** May be taken unlimited times for up to 99 credits**CE F698 Non-thesis Research/Project**

1-6 Credits

**Lecture + Lab + Other:** 0 + 0 + 0**Grading System:** Pass/Fail Grades**Repeatable for Credit:** May be taken unlimited times for up to 99 credits

**CE F699 Thesis**

1-15 Credits

**Lecture + Lab + Other:** 0 + 0 + 0

**Grading System:** Pass/Fail Grades

**Repeatable for Credit:** May be taken unlimited times for up to 99 credits