CIVIL ENGINEERING (CE)

CE F112  Elementary Surveying
3 Credits
Offered Spring
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

CE F302  Fundamentals of Transportation Engineering
3 Credits
Offered Spring
Introduces multi-modal transportation systems including highways, airports railroads and water transportation. Factors that influence planning, design and operation of these systems is discussed. Highway systems are emphasized in the course.
Prerequisites: CE junior standing.
Lecture + Lab + Other: 3 + 0 + 0

CE F326  Introduction to Geotechnical Engineering
4 Credits
Offered Spring
Fundamentals of geotechnical engineering including identification and classification of soil, physical and mechanical properties of soil, subsurface exploration, laboratory testing techniques, seepage, compaction, stresses in soil, soil consolidation, and drained and undrained shear strength of soil.
Prerequisites: ES F331; GE F261.
Lecture + Lab + Other: 3 + 3 + 0

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 and introduction to matrix methods.
Prerequisites: ES F209; ES F331.
Lecture + Lab + Other: 2 + 3 + 0

CE F334  Properties of Materials
3 Credits
Offered Fall
Corequisite: ES F331.
Lecture + Lab + Other: 2 + 3 + 0

CE F341  Environmental Engineering
4 Credits
Offered Spring
Introduces fundamentals of environmental engineering including theory and application of water and wastewater, solid waste and air quality engineering practice; natural processes that influence pollutant fate and use of these processes in engineered systems for pollution control.
Prerequisites: CHEM F106X; or graduate standing.
Lecture + Lab + Other: 3 + 3 + 0

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

CE F405  Highway Engineering
3 Credits
Offered Fall
Design of geometric elements of streets and highways with emphasis on safety and efficiency. Roadway functional classification, design controls, vertical and horizontal alignments, cross sections, interchanges and intersections.
Corequisite: CE F302.
Lecture + Lab + Other: 2 + 3 + 0

CE F406  Traffic Engineering
3 Credits
Offered Fall
Operation and control of transportation systems with emphasis on traffic on highways and streets. Traffic control devices, data collection, capacity and level of service analysis, intersection signalization, traffic impact analysis, accident analysis and other safety considerations.
Prerequisite: CE F302.
Stacked with CE F606.
Lecture + Lab + Other: 2 + 3 + 0

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

CE F424  Introduction to Permafrost Engineering (a)
3 Credits
Offered Fall
Introduction to 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, methods of thermal analysis of soil freezing and thawing, foundations design alternatives, pipelines, roads and airfields in the permafrost region.
Prerequisites: CE F326.
Recommended: CE F422; GE F384.
Stacked with CE F624.
Lecture + Lab + Other: 3 + 0 + 0

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
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<tr>
<th>Course Code</th>
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<td>CE F433</td>
<td>Reinforced Concrete Design</td>
<td>3</td>
<td>Fall</td>
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<td>CE F434</td>
<td>Timber Design</td>
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<td>CE F435</td>
<td>Design and Construction of Bridges</td>
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<td>CE F437</td>
<td>Design of Engineered Systems I</td>
<td>3</td>
<td>Fall</td>
<td>CE F331; ES F331.</td>
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<td>CE F438</td>
<td>Design of Engineered Systems II</td>
<td>3</td>
<td>Spring</td>
<td>ES F331; CE F344.</td>
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<td>CE F442</td>
<td>Environmental Engineering Design</td>
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<td>CE F341.</td>
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<td>CE F443</td>
<td>Air Pollution Management</td>
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<td>Increasing engineering joke: CE F341.</td>
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<td>CE F445</td>
<td>Hydrologic Analysis and Design</td>
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<td>Spring</td>
<td>CE F344.</td>
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<td>CE F451</td>
<td>Construction Cost Estimating and Bid Preparation</td>
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<td>Fall</td>
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<td>CE F463</td>
<td>Groundwater Dynamics</td>
<td>3</td>
<td>Spring</td>
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**Prerequisites:**
- CE F331
- ES F331
- CHEM 106X; graduate standing
- CE F432
- CE F434
- MATH F252X
- CE F344
- College math
- CE F344
- CE F663
- CE F344
- CE F442
- CE F344
- CE F443
- CE F445
- CE F451
- CE F463

**Recommended:**
- College math
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

CE F606 Traffic Engineering
3 Credits
Operation and control of transportation systems with emphasis on traffic on highways and streets. Traffic control devices, data collection, capacity and level of service analysis, intersection signalization, traffic impact analysis, accident analysis and other safety considerations.
Prerequisite: CE F602.
Stacked with CE F406.
Lecture + Lab + Other: 2 + 3 + 0

CE F607 GIS Applications in Civil Engineering
3 Credits
Offered Fall 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: 3 + 0 + 0

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

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

CE F624 Introduction to Permafrost Engineering (a)
3 Credits
Offered Fall
Introduction to 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, methods of thermal analysis of soil freezing and thawing, foundations design alternatives, pipelines, roads and airfields in the permafrost region.
Prerequisites: Training or experience in soil mechanics.
Stacked with CE F424.
Lecture + Lab + Other: 3 + 0 + 0
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  

CE F626  Thermal Geotechnics  
3 Credits  
Offered As Demand Warrants  
Prerequisites: CE F326; CE F422.  
Cross-listed with GE F626.  
Lecture + Lab + Other: 3 + 0 + 0  

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  

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  

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  

CE F631  Advanced Structural Analysis  
3 Credits  
Offered Spring Odd-numbered Years  
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  

CE F633  Theory of Elastic Stability  
3 Credits  
Offered Spring Odd-numbered Years  
The theory and implementation of the buckling of slender elements will be covered. Both lateral and local buckling concepts will be discussed. Emphasis will be placed on developing the ability to evaluate if a member is likely to buckle. The course will cover elastic and inelastic buckling of columns. Other topics include lateral torsional buckling of beams, potential buckling of beam-columns and rigid frame members and the buckling of non standard shapes.  
Prerequisites: CE F331; CE F432; MATH F302.  
Lecture + Lab + Other: 3 + 0 + 0  

CE F634  Structural Dynamics  
3 Credits  
Offered As Demand Warrants  
This course covers the theory of structural dynamics. Subjects include equations of motion for un-damped single and multiple degree of freedom systems. Free vibration and response to harmonic and periodic excitations will be studied. Response to arbitrary, step and pulse type excitations are studied in preparation for a study of earthquake type loading. The basic concepts related to the interaction of a structure to an earthquake event will be discussed.  
Prerequisites: ES F210; CE F331; MATH F302.  
Lecture + Lab + Other: 3 + 0 + 0  

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, elasto-plastic 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  

CE F637  Earthquakes: Seismic Response of Structures  
3 Credits  
Offered As Demand Warrants  
Fundamentals of structural earthquake engineering: strong ground motion phenomena; dynamic analysis of structural systems for seismic motion; response spectrum and time history methods, design of structural systems for lateral forces; shearwalls and diaphragms; moment-resistive frames, braced frames; current design criteria and practice; connection details, serviceability requirement; story drift, non-structural building elements; soil-structure interaction.  
Prerequisites: ES F210.  
Lecture + Lab + Other: 3 + 0 + 0  

CE F640  Prestressed Concrete  
3 Credits  
Offered As Demand Warrants  
Prerequisites: CE F331; CE F433.  
Recommended: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0
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

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

CE F652C  Pre-Construction Contracts  
1 Credit  
Offered As Demand Warrants  
Provides an introduction to determining scope and scheduling needs for architectural and engineering contracts and other design-related contracts. A review of type of contracts and procurement methods available. Handling changes within the pre-construction contract.  
Lecture + Lab + Other: 4.5 + 0 + 0

CE F659A  Mentoring  
1 Credit  
Offered As Demand Warrants  
This course will provide insight into how to "train the trainer." It will incorporate the role of HR in department and relevant case studies to enable students to understand key principles, and learn skills and behaviors to enhance knowledge transfer.  
Lecture + Lab + Other: 4.5 + 0 + 0

CE F660A  Project Management Boot Camp  
1 Credit  
Offered As Demand Warrants  
This course provides "basic training" in project management fundamentals, with emphasis on the management of engineering and construction projects. Much of the discussion is centered on the "triple constraint" of cost, schedule, and quality/scope. Topics include project characteristics; the project life cycle; project organizations, teams and leadership; planning, monitoring and controlling each element of the triple constraint; and project termination and phase-out. Planning issues include the project charter and scope statement, the work breakdown structure, and both network- and non-network-based scheduling techniques.  
Lecture + Lab + Other: 4.5 + 0 + 0

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

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

CE F663  Groundwater Dynamics  
3 Credits  
Offered Fall Even-numbered Years  
Fundamentals of geohydrology, hydraulics of flow through porous media, well hydraulics, groundwater pollution and groundwater resources development.  
**Corequisites:** CE F344.  
Stacked with CE F463.  
Lecture + Lab + Other: 3 + 0 + 0

CE F664  Sediment Transport  
3 Credits  
Offered Spring Even-numbered Years  
**Prerequisites:** Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0

CE F665  Introduction to Watershed Hydrology  
3 Credits  
Offered Fall Even-numbered Years  
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, evaporation, water in soils and stream response to water-input events. Offered Fall Even-numbered Years.  
**Prerequisites:** MATH F253X; PHYS F211X.  
Lecture + Lab + Other: 3 + 0 + 0

CE F668  Ice Engineering  
3 Credits  
Offered Spring Odd-numbered Years  
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

CE F668A  Arctic Hydrology and Hydraulic Engineering  
3 Credits  
Offered Fall Odd-numbered Years  
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
CE F684  Arctic Utility Distribution  (a)  
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

CE F685  Topics in Frozen Ground Engineering  (a)  
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

CE F692  Seminar  
1-3 Credits  
Lecture + Lab + Other: 0 + 0 + 0

CE F698  Non-Thesis Research/Project  
1-6 Credits  
Lecture + Lab + Other: 0 + 0 + 0

CE F699  Thesis  
1-15 Credits  
Lecture + Lab + Other: 0 + 0 + 0