## Civil Engineering (CE)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Semester</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>CE F112</td>
<td>Elementary Surveying</td>
<td>3</td>
<td>Spring</td>
<td>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</td>
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<tr>
<td>CE F302</td>
<td>Introduction to Transportation Engineering</td>
<td>3</td>
<td>Spring</td>
<td>Introduction to multimodal transportation systems and the factors that influence the planning, design and operation of the systems. Prerequisites: CE junior standing or permission of instructor. Lecture + Lab + Other: 3 + 0 + 0</td>
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<tr>
<td>CE F326</td>
<td>Introduction to Geotechnical Engineering</td>
<td>4</td>
<td>Spring</td>
<td>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</td>
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<tr>
<td>CE F331</td>
<td>Structural Analysis</td>
<td>3</td>
<td>Spring</td>
<td>Analysis of statically determinate and indeterminate structures to include beams, trusses and frames. Internal force resultants, shear and moment diagrams, deflections, internal stresses. Influence lines and criteria for moving loads. Indeterminate analysis to include methods of consistent deflections, slope deflection and moment distribution. Introduction to matrix methods. Prerequisites: ES F209; ES F331. Lecture + Lab + Other: 2 + 3 + 0</td>
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<tr>
<td>CE F341</td>
<td>Environmental Engineering</td>
<td>4</td>
<td>Spring</td>
<td>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. Special fees apply. Prerequisites: CHEM F106X; or graduate standing. Lecture + Lab + Other: 3 + 3 + 0</td>
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<tr>
<td>CE F344</td>
<td>Water Resources Engineering</td>
<td>3</td>
<td>Fall</td>
<td>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</td>
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<tr>
<td>CE F405</td>
<td>Highway Engineering</td>
<td>3</td>
<td>Fall</td>
<td>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. Co-requisite: CE F302 or permission of instructor. Lecture + Lab + Other: 2 + 3 + 0</td>
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<tr>
<td>CE F406</td>
<td>Traffic Engineering</td>
<td>3</td>
<td>Fall</td>
<td>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</td>
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<tr>
<td>CE F422</td>
<td>Foundation Engineering</td>
<td>3</td>
<td>Fall</td>
<td>Bearing capacity of soils and effects of settlements on structure. Design of footings and rafts, pile and pier foundations, retaining walls and anchored bulkheads. Foundations on frozen soils and construction problems in foundation engineering. An introduction to slope stability analysis. Prerequisites: CE F326; ES F301. Lecture + Lab + Other: 3 + 0 + 0</td>
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<tr>
<td>CE F424</td>
<td>Introduction to Permafrost Engineering</td>
<td>3</td>
<td>Fall</td>
<td>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; or permission of instructor. Recommended: CE F422; GE F384. Stacked with CE F624. Lecture + Lab + Other: 3 + 0 + 0</td>
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<tr>
<td>CE F432</td>
<td>Steel Design</td>
<td>3</td>
<td>Fall</td>
<td>Design philosophies and current practice related to steel design are covered. Describes how the understanding modes of failure are used to design structural members with an appropriate factor of safety to satisfy strength and serviceability (performance). Tension members, fasteners, welds, column buckling, beam behavior and beam-columns will be discussed. The current AISC specifications are used. Prerequisites: CE F331; ES F331. Lecture + Lab + Other: 2 + 3 + 0</td>
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CE F433  Reinforced Concrete Design
3 Credits
Offered Spring
Prerequisites: CE F331; ES F331.
Lecture + Lab + Other: 3 + 0 + 0

CE F434  Timber Design
3 Credits
Offered Fall Odd-numbered Years
Prerequisites: CE F331; ES F331.
Lecture + Lab + Other: 3 + 0 + 0

CE F435  Design and Construction of Bridges
3 Credits
Offered Spring
Design-build technology for bridge structures is introduced. A bridge system is developed for a given crossing with predetermined specifications. Alternate designs are developed. These alternatives are based on design calculations, prepared drawings and suitability. Design ideas are developed and tested to verify if the idea meets the design assumptions. Techniques in design, fabrication, fund raising, project management, fiscal responsibility, safety, public speaking and teamwork are learned and used during the semester. The final structure will be load tested and graded based on meeting the goals of the specification.
Prerequisites: Permission of instructor.
Recommended: CE F432.
Lecture + Lab + Other: 1 + 6 + 0

CE F437  Design of Engineered Systems I
3 Credits
Offered Fall
Critical skills for a successful engineer with emphasis on: project planning; preliminary investigations; permitting; reading, interpreting, and creating plans and specification; use and technical applications of AutoCAD; proposal writing and project management; continuing education and professional registration. Civil engineering major with senior standing; COJO F131X or COJO F141X; WRTG F111X or WRTG F211X or WRTG F211X or WRTG F213X.
Lecture + Lab + Other: 3 + 0 + 0

CE F438  Design of Engineered Systems II
3 Credits
Offered Spring
System design principles using service learning projects with civil and environmental engineering focus. Practical applications of concepts covered in CE F437: ethics, liability and legal principles to professional practice. Emphasis on teamwork and leadership.
Prerequisites: COJO F131X or COJO F141X; WRTG F111X; WRTG F211X or WRTG F213X; CE F405 or CE F422 or CE F432 or CE F433 or CE F434 or CE F442 or CE F445; CE F437.
Lecture + Lab + Other: 3 + 0 + 0

CE F442  Environmental Engineering Design
3 Credits
Offered Fall
Design of pollution control and remediation systems. Theories and principles for the design of engineering systems for environmental protection, management and control. Water and wastewater treatment and solid waste management.
Prerequisites: CE F341.
Lecture + Lab + Other: 3 + 0 + 0

CE F443  Air Pollution Management
3 Credits
Offered Spring Odd-numbered Years
Air pollution topics including the quantity and quality of atmospheric emissions and their effects on the human environment. Identification and location of sources, measurement of quality and conformance with standards. Legal considerations of Clean Air Act and Amendments and local regulations. Evaluation of stationary and moving sources. Meteorology and modeling requirements. Control mechanisms for gases and particulates.
Prerequisites: CHEM 106X or equivalent.
Recommended: MATH F252X; graduate standing; or permission of instructor.
Stacked with ENVE F643.
Lecture + Lab + Other: 3 + 0 + 0

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

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

CE F463  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. Co-requisite: CE F344.
Stacked with CE F663.
Lecture + Lab + Other: 3 + 0 + 0

CE F444  Engineering Design I
3 Credits
Offered Fall
Design, analysis, and implementation of solutions to civil engineering problems. Emphasis on the application of computer software tools to solve civil engineering problems.
Prerequisites: CE F344.
Lecture + Lab + Other: 3 + 0 + 0
CE F470  Civil Engineering Internship
1 Credit
Supervised engineering field and work experience. Assignments
individually arranged with cooperating agencies and must include data
collection and reporting. As part of the requirements for earning credit,
the student must have a letter of release from the company, prepare a
written report and make an oral presentation. Program must be approved
in advance by the department. This course is graded Pass/Fail.
Prerequisites: Upper division standing; permission of department
coordinator.
Lecture + Lab + Other: 0 + 3 + 0

CE F471  Field Practicum
1 Credit
Offered Fall
Introduction to field data collection techniques used in civil engineering
sub-disciplines such as structural, traffic, water, environmental and
materials; preliminary data analysis and descriptive statistics.
Prerequisites: Senior standing in CEE program; or permission of
instructor.
Lecture + Lab + Other: 0 + 3 + 0

CE F490  Civil Engineering Seminar
0.5 Credit
Offered Fall
CE F490-F491, together, constitute the standard one-year engineering
seminar. The class is designed to provide the student with exposure
to the latest information available from researchers and practicing
professionals in industry.
Prerequisites: Junior/senior standing.
Lecture + Lab + Other: 0.5 + 0 + 0

CE F491  Civil Engineering Seminar
0.5 Credit
Offered Spring
CE F490-F491, together, constitute the standard one-year engineering
seminar. The class is designed to provide the student with exposure
to the latest information available from researchers and practicing
professionals in industry.
Prerequisites: Junior/senior standing.
Lecture + Lab + Other: 0.5 + 0 + 0

CE F492  Seminar
1-3 Credits
Lecture + Lab + Other: 0 + 0 + 0

CE F492P  Seminar
1-3 Credits
Lecture + Lab + Other: 0 + 0 + 0

CE F498  Research
1-6 Credits
Lecture + Lab + Other: 1-6 + 0 + 0

CE F601  Engineering Research Communication
3 Credits
Offered Spring
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

CE F603  Arctic Engineering  (a)
3 Credits
Application of engineering fundamentals to problems of advancing
civilization to polar regions. Logistics, foundations on frozen ground
and ice thermal aspects of structures, materials, transport and
communications, and heating and ventilating.
Recommended: Senior standing or B.S. degree in engineering; or
permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CE F605  Pavement Design
3 Credits
Offered As Demand Warrants
Current design techniques for flexible and rigid pavements. Materials
characterization, loading considerations, empirical design methods,
mechanistic design methods and rehabilitation.
Recommended: CE F402; graduate standing, or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CE F606  Traffic Engineering
3 Credits
Offered As Demand Warrants
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 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. Graduate standing in CE; or permission of instructor.
Lecture + Lab + Other: 2 + 3 + 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 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0
CE F624  Frozen Ground Engineering (a)
3 Credits
Offered Fall
Nature of frozen ground, thermal properties of frozen soils, classification, physical and mechanical properties of frozen soils, subsurface investigation of frozen ground and hazards, thaw settlement and thaw consolidation, slope stability and principles of foundation design in frozen ground.
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 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CE F626  Thermal Geotechnics
3 Credits
Offered As Demand Warrants
Prerequisites: CE F326; CE F422; CE F425; or permission of instructor.
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 or permission of instructor.
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 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CE F632  Advanced Structural Design
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 F422; MATH F302.
Lecture + Lab + Other: 3 + 0 + 0

CE F633  Theory of Elastic Stability
3 Credits
Offered Spring Odd-numbered Years
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 F634  Structural Dynamics
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; or permission of instructor.
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 or permission of instructor.  
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 or permission of instructor.  
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; or permission of instructor.  
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.  
Prerequisites: Permission of instructor.  
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.  
Recommended: Permission of instructor.  
Stacked with CE F463.  
Lecture + Lab + Other: 3 + 0 + 0

CE F664  Sediment Transport  
3 Credits  
Offered Spring Even-numbered Years  
Prerequisites: Graduate standing or permission of instructor.  
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, evapotranspiration, water in soils and stream response to water-input events. Offered Fall Even-numbered Years  
Prerequisites: MATH F253X; PHYS F211X; or permission of instructor.  
Lecture + Lab + Other: 3 + 0 + 0
CE F682  Ice Engineering  (a)  
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 F683  Arctic Hydrology and Hydraulic Engineering  (a)  
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 or equivalent.  
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 or permission of instructor.  
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 F681.  
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