

# ECIV - Civil Engineering

## ECIV 101 Intro To Civil Engineering: 1 Credits (1 Lec)

PREREQUISITE: Must be taken within your freshman year. This course is optional for students entering civil engineering but is encouraged for freshmen wanting to learn about the breadth of the discipline. Students choosing to take the course will be introduced to civil engineering, including department programs and areas of specialty, civil engineering career options, professionalism, history, and ethics

## ECIV 120 Infrastructure & Society: 3 Credits ()

(F) On demand. Physical infrastructure is a critical element in the foundation of our society, being both shaped by our societal values, goals and technical abilities and simultaneously shaping our social and economic landscape. Our federal, state and local governments spend hundreds of billions of dollars on infrastructure each year (over \$400 billion, for example, in 2014). Despite the importance of this infrastructure in our daily lives and the magnitude of our investment in it, most individuals lack a basic understanding of how infrastructure systems work, how they are paid for and the consequences of our individual and societal choices relative to the built environment. One result of this situation is that America's basic infrastructure is deteriorating with major long term impacts to our safety, health and economic prosperity. This course will provide a basic understanding of how the nation's water, wastewater, solid waste, transportation, electrical power and communications systems are designed and operated. The decision-making processes through which infrastructure projects are initiated and funded will be described and discussed. The manner in which individual choices and actions impact basic infrastructure systems will be explored and discussed. Development of more sustainable systems will be researched.

## ECIV 202 Applied Analysis: 1 Credits (1 Lab)

PREREQUISITE: M 165Q or M 171Q or M 181Q; Civil Engineering or CE/Bio-Resources Option Engineering or Environmental Engineering majors only. Computer applications in civil engineering using M-based software and a programming language. -

## ECIV 231 Introduction to Engineering Hydrology: 3 Credits (3 Lec)

PREREQUISITE: M 171Q. (F, Sp) The course focuses on the fundamental physical processes, computations, and data that drive water resource design and has a specific emphasis on groundwater and surface-water hydrology. Students will be presented numerous examples of real-world applications of water resources systems, gain an awareness of the sources and availability of existing data, perform fundamental hydrologic and groundwater calculations, and be able to discuss the role of risk and uncertainty in water resource design

## ECIV 290R Undergraduate Research: 1-6 Credits (1-6 Other)

() On demand. Directed undergraduate research which may culminate in a written work or other creative project. Course will address responsible conduct of research. May be repeated. Repeatable up to 99 credits.

## ECIV 291 Special Topics: 1-4 Credits (1-4 Lec)

PREREQUISITE: None required but some may be determined necessary by each offering department. On demand. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number Repeatable up to 12 credits.

## ECIV 307 Construction Estimating and Bidding: 3 Credits (2 Lec, 1 Lab)

PREREQUISITE: ECIV 202 or ETCC 204, and ECIV 308. Preparation of cost estimates and bids for construction projects. Introduction of computer estimating software and procedures. -

## ECIV 308 Construction Practice: 3 Credits (3 Lec)

PREREQUISITE: EGEN 201 or EGEN 203; and DDSN 131. (F, Sp) Introduction to the construction company and project operations and an overview of the construction industry in general. Topic areas include contract documents, insurance and bonding, labor and labor law, business organization, leadership, ethics, environmental and financial aspects

## ECIV 309 Building Information Modeling in Construction: 3 Credits (3 Lec)

PREREQUISITE: EGEN 115 and DDSN 101 or DDSN 131. Introduction to the use of Building Information Modeling (BIM) in the Construction Industry. Instruction in BIM basics using contemporary software, with hands-on exercises in typical construction applications

## ECIV 311 Construction Project Documentation: 2 Credits (2 Lec)

PREREQUISITE: ECIV 308 and student must be within two semesters of graduation. Review and development of various administrative instruments required for project management, including plans and specifications, business communications, submittals, contracts, financial reports, contract risk and pass through clauses, labor issues and legislation, submittals, claims and disputes, change orders, quality control plans and reports, project close outs and productivity analyses

## ECIV 312 Structures I: 3 Credits (3 Lec)

PREREQUISITE: EGEN 205. Study of loading on structures. Study of structural systems and systems modeling. Analysis of determinate and indeterminate structures. Introduction to matrix methods. Introduction to structural analysis software. Introduction to design approaches and philosophies

## ECIV 315 Structures II: 3 Credits (2 Lec, 1 Lab)

PREREQUISITE: ECIV 312. Structural design of steel and reinforced concrete members used in buildings and bridges. Theory and application of design codes. Laboratory experience utilizing construction materials

## ECIV 320 Geotechnical Engineering: 3 Credits (2 Lec, 1 Lab)

PREREQUISITE: EGEN 205. The treatment of soil as an engineering material. Fundamental soil mechanics principles and introductory solutions to geotechnical engineering problems. Basic soil mechanics laboratory tests and procedures

## ECIV 333 Water Resources Engineering: 4 Credits (3 Lec, 1 Lab)

PREREQUISITE: ECIV 231 and ECIV 337 and EGEN 350 or STAT 332. (F, Sp) Descriptive and quantitative hydrology with applications in water resources engineering. Pipe flow, open channel flow, and hydraulic machines with applications in water resources engineering

## ECIV 334 Heavy Civil Construction Planning & Estimating: 3 Credits (3 Lec)

This course will cover planning and cost estimation for construction of highways, bridges, tunnels, dams and other heavy civil projects including fleet management.

## ECIV 337 Civil Engineering Fluid Mechanics: 3 Credits (3 Lec)

PREREQUISITES: EGEN 201 Fundamental concepts developed in the course include fluid statics, conservation of mass, energy and momentum using Reynolds Transport Theorem, kinematics, plane potential flow, lift and drag. Applications focus on civil engineering problems including closed conduit and open channel hydraulics

## ECIV 350 Transportation Engineering: 3 Credits (2 Lec, 1 Lab)

PREREQUISITE: Junior standing. Introduction to vehicle operating characteristics, geometric and pavement design, traffic flow theory, signal design and analysis, capacity analysis and planning. Laboratory work will introduce various in-practice software packages

**ECIV 360 Estimating & Bidding Fundamentals: 1-2 Credits (1-2 Lec, 1-2 Lab)**

(F) This course will introduce students to the fundamentals of preparing construction work plans, site logistics, and scope sequencing to create a construction schedule. Students will also develop skills that include quantity takeoff, cost estimating and project bidding that will culminate with a written proposal and defense of proposal with a presentation and QA session.

Repeatable up to 3 credits.

**ECIV 401 Civil Eng Practice and Ethics: 1 Credits (1 Other)**

PREREQUISITE: Concurrent registration with ECIV 489R required. Professional ethics, social responsibility, public policy, and leadership

**ECIV 404 Heavy Const Equip and Methods: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: ETCC 302 or ECIV 320. Construction equipment operating characteristics, economics, and production rate estimation. Heavy construction methods associated with tunneling, aggregate production, and mass earthwork operations

**ECIV 405 Construction Project Planning and Scheduling: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: ECIV 308. Project planning and scheduling procedures involving both network (CPM) and non-network techniques. Introduction to computer scheduling software

**ECIV 406 Sustainability Issues in Construction: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 308. Review sustainability issues in the construction industry, including LEED; green practices; energy systems and renewable energy; water resources; storm and waste water; life cycle assessment; building health issues

**ECIV 414 Steel Design: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 315. () Fall, odd years. Design of structural steel members and systems

**ECIV 415 Design of Masonry Structures: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 315. () Spring, even years. Introduction to masonry design. Integrated building design from the roof to the foundation. Including load calculations, structural roof and floor elements and connections. Emphasis on low-rise buildings

**ECIV 416 Design of Wood and Timber Structures: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 315. () Spring, odd years. Introduction to the basic behavior of wood and timber structures. Design of wood and timber components and structures using contemporary building codes

**ECIV 417 Heavy Civil Construction Practices: 3 Credits (3 Lab)**

PREREQUISITE: ECIV 308 Construction Practices. Heavy Civil Construction Practices will cover project management methods, environmental mitigation practices, safety and trenchless and other current heavy civil technologies and well as look at professional management practices for heavy civil projects

**ECIV 420 Earth and Foundation Engr: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 320. Application of soil mechanics principles to the analysis and design of conventional shallow foundations, mat foundations, and deep foundation systems

**ECIV 425 Geotechnical Structures: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 320. Analysis of lateral earth pressures and design of geotechnical structures including retaining walls, MSE walls, sheet pile walls, and braced excavations. Stability analysis of natural and engineered slopes. Analysis and design of embankments and dams

**ECIV 431 Open Channel Hydraulics: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 333. (F) Principles of open channel flow; hydraulic design of open channel structures

**ECIV 435 Closed-Conduit Hydraulics: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 333. (Sp) Advanced topics in hydraulic engineering, with emphasis on analysis and design of pipe transmission lines, pumps, and pipe distribution networks

**ECIV 444 Civil Engineering Computations: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 202 and M 273. (Sp) The focus of this course is to teach students to appreciate and use various computational tools to solve complex civil engineering problems. Specifically, this course will focus on the MATLAB programming language and will cover a comprehensive set of tools and methods available in this program

**ECIV 450 Bicycle, Pedestrian, and Transit Design: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 350. (F) The Bicycle, Pedestrian, and Transit Design course covers the design, planning, implementation and operations of both dedicated and mixed-use facilities for these transportation modes. Attention will be given to both quantitative and qualitative problem-solving skills that are trademarks of a successful engineering professional

**ECIV 451 Highway Pavements: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: ECIV 350 and ECIV 320. () Spring, even years. Design of highway pavements including drainage and base/subbase/subgrade preparation. Laboratory in bituminous materials

**ECIV 452 Traffic Engineering and ITS: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: ECIV 350. () Fall, odd years. Application of driver, vehicle, and roadway characteristics to principles of traffic control, operations, and safety. Traditional and advanced technology solutions will be explored. -

**ECIV 454 Transportation Planning: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 350 and EGEN 350 or STAT 332. (Spring, odd years.) Urban transportation planning and travel demand forecasting including land use and transportation interaction, land use models and the traditional four-step travel demand forecasting process, traffic impact and parking studies, and the evaluation of alternative transportation plans

**ECIV 455 Survey Data Collection & Analysis for Transportation Engineering: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: EGEN 350 or EIND 354 or consent of instructor. () Spring, even years. Course introduces students to the principles and practice of survey and data analysis for transportation engineering and elevates students' ability to design and apply scalable approaches to analyze transportation-related data. Transportation survey design, implementation and analysis are covered. Methods and techniques for anticipating traffic events (crashes, congestion, etc.) are studied. Co-convened w/ECIV 555

**ECIV 456 Highway Geometric Design: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 350. Advanced geometric design of highway systems including two-lane, interstate roadways, roundabouts, and intersection design elements

**ECIV 457 MDT Highway Design: 3 Credits (1 Lec, 2 Lab)**

PREREQUISITE: Consent of instructor. (F) Course providing training on the pre-construction design process of highway projects at the Montana Department of Transportation. This course is offered to students in cooperation with MD Design Unit in Bozeman. The course is intended to follow summer employment with MDT Design Unit

**ECIV 459 Sustainable Transportation & Community Health: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 350 or consent of instructor. (Sp) This class is intended to bring together ideas in engineering, community health, planning, and policy disciplines to study the relationship between transportation and public health. The course will introduce students to how transportation systems evolved in the U.S. and in the Netherlands, and the design standards that go along with active transportation infrastructure. Students will compare how different land use patterns and the built environment influence how we travel and our public health outcomes

**ECIV 460 Advanced Estimating & Bidding: 1-2 Credits (1-2 Lec, 1-2 Lab)**

PREREQUISITE: ECIV 360. (F) This course will build upon the fundamentals learned in ECIV 360 with the addition of taking on a leadership role and preparing information briefings. Students will take on a leadership role in supervising and assessing their team's development of preparing construction work plans, site logistics, and scope sequencing to create a construction schedule for real projects. Students will also advance their skills in quantity takeoff, cost estimating and project bidding that will culminate with a written proposal and defense of proposal with a presentation and Q&A session for real projects  
Repeatable up to 3 credits.

**ECIV 461 Cold Regions Infrastructure Engineering: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 320 or ETCC 302, EGEN 331 or EGEN 335  
COREQUISITE: ECIV 308. () On demand. This course explores the challenges of cold regions infrastructure engineering. Design, construction and performance issues specific to cold climates are identified, and methods to overcome them are developed and demonstrated  
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**ECIV 464 Lightweight Concrete Engineering: 1-3 Credits (1-3 Lec)**

(F, Sp) Students work together towards the successful design and build of a concrete structure (generally a canoe). Focus areas generally include lightweight concrete mix design, hull design, structural analysis, formwork design, reinforcement design, construction/implementation, sustainability, transport, and theme and creativity.  
Repeatable up to 3 credits.

**ECIV 484 Reinforced Concrete Design: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 315. () Fall, even years. Design of reinforced concrete members and systems

**ECIV 489R Civil Engineering Design I: 2 Credits (1 Lec, 1 Lab)**

PREREQUISITE: ECIV 308 or ECIV 315 AND ECIV 320 or ECIV 333, AND ECIV 350

COREQUISITE: EGEN 325 or EGEN 330. (F, Sp) Concurrent registration with ECIV 401 is required. Senior capstone course. Discussion of the design process from conceptual/preliminary design to final design, plans, and specifications. Develop proposal for engineering services, including scope of work, data acquisition, and organization of design team  
.

**ECIV 490R Undergraduate Research: 1-4 Credits (1 Other)**

(F, Sp, Su) Directed undergraduate research/creative activity which may culminate in a research paper, journal article, or undergraduate thesis. Course will address responsible conduct of research. May be repeated.  
Repeatable up to 12 credits.

**ECIV 491 Special Topics: 1-4 Credits (1 Lec)**

PREREQUISITE: Upper division courses and others as determined for each offering. On demand. Courses not required in any curriculum for which there is a particular one time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number

Repeatable up to 12 credits.

**ECIV 492 Independent Study: 1-6 Credits (1-6 Other)**

PREREQUISITE: Junior standing, consent of instructor, and approval of Department Head. (F, Sp, Su) Directed research and study on an individual basis

Repeatable up to 6 credits.

**ECIV 498 Internship: 3 Credits (3 Other)**

PREREQUISITE: Junior standing, consent of instructor and approval of Department Head. An individualized assignment arranged with an agency, business, or other organization to provide guided experience in the field. Students may not take this course the semester they graduate  
Repeatable up to 12 credits.

**ECIV 499R Capstone: Civil Engineering Design: 3 Credits (1 Lec, 2 Lab)**

PREREQUISITE: ECIV 333 and ECIV 312 and EGEN 310R. (F, Sp) Senior capstone course for civil engineering students. Students work in teams on design of an engineering project, integrating technical and professional skills. Projects include evaluation of design alternatives and communication of design recommendations. Lecture content may include topics relevant to the project completion, including project management, cost estimates, and engineering services during construction. Students must be in final semester of the degree program

**ECIV 504 Construction Productivity: 3 Credits (3 Lec)**

PREREQUISITE: Two years of construction field experience required.  
() No longer offered. Management concepts will include human factors as well as enlightened leadership and advanced management concepts. Productivity improvement data collection, analysis, and solutions to include the construction work force and cost

**ECIV 505 Quality Assurance and Risk Management: 3 Credits (3 Lec)**

PREREQUISITE: Either EGEN 350, EIND 354 or STAT 332 and ECIV 308 or equivalent plus one year of industrial experience or one internship (ECIV 498 or ETCC 498). () No longer offered. Analysis of quality assurance and control concepts to include utilization of statistical analysis. Application of risk analysis principles to the construction process to minimize liability and project costs

**ECIV 506 Ad Construction Management: 3 Credits (3 Lec)**

PREREQUISITE: One year of industrial experience or one internship (ECIV 498 or ETCC 498)

COREQUISITE: ETCC 499 or equivalent. () No longer offered.

Broad issues of construction sustainability (LEED, Lean Construction, Environmental requirements, etc.) and how the construction industry needs to manage this process  
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**ECIV 507 Law of the Construction Industry: 3 Credits (3 Lec)**

() On demand. ONLINE ONLY. This class exposes engineers to the effect of law, rules and regulations on their work both from a practical perspective, for example, what engineers should know about basic concepts of contract law, to more abstract concepts like whether, and in what manner, government should mandate green construction practices. It is about understanding how the construction industry works within a framework of rules and regulations, critically considering whether the rules help or hinder the construction process and most importantly, how you as future leaders in the engineering profession are going to make the process better.

**ECIV 511 Building Structural Systems: 2 Credits (2 Lec)**

PREREQUISITE: ECIV 484 or ECIV 414 or ECIV 415 or ECIV 416

COREQUISITE: ECIV 512. () On demand. Analysis of multistory structural systems. Emphasis on lateral force resisting systems in steel framed buildings  
.

**ECIV 512 Structural Dynamics: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 312. () Fall, even years. Response of structures to dynamic loads, including seismic loads

**ECIV 513 Behavior of Concrete Structure: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 484. () Spring, odd years. Behavior of reinforced concrete members, frames, and shear wall systems. Significance of behavior in design of reinforced concrete structures

**ECIV 514 Behavior of Steel Structures: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 414. () Spring, even years. Behavior of steel members and frames. Significance of behavior in design of steel structures

**ECIV 515 Adv Structural Analysis: 3 Credits (3 Lec)**

PREREQUISITE: EGEN 415. () Spring, even years. This course presents the theoretical background behind common finite elements used by structural engineers. This course will allow students to utilize finite element structural engineering software in an informed manner. Application of design software for typical structures will be practiced. Interconnection of FEA software and design codes will be explored

**ECIV 519 Bridge and Prestressed Concrete Design: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 315. () Fall, odd years. Design of concrete structures utilizing pre- and post-tensioned concrete elements. Introduction to bridge analysis and design

**ECIV 521 Applied Geotechnical Engin: 3 Credits (2 Lec, 2 Lab)**

PREREQUISITE: ECIV 320. () Fall, even years. Principles of geotechnical site investigations and advanced laboratory testing for the purpose of characterizing soils and the determination of engineering soil properties used in the design of soil structures

**ECIV 524 Advanced Soil Mechanics: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 320. () Fall, odd years. Topics leading to an advanced understanding of the engineering behavior of soils with an emphasis on settlement and shear strength

**ECIV 526 Geotechnical Aspects of Earthquake Engineering: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 320. () Fall, odd years. Principles of engineering seismology and geotechnical earthquake engineering. Focus is on advanced principles, evaluation procedures, and design methods

**ECIV 529 Groundwater Contamination: 3 Credits (3 Lec)**

PREREQUISITE: EGEN 335 or ECIV 337 or ECHM 321. Introduction to fundamental concepts, applied analysis and design related to groundwater flow, well mechanics, contaminant transport and remediation technologies. Co-convened with EENV 434, graduate students who took EENV 434 as undergraduates should not take ECIV 529

**ECIV 530 Adv Hydraulic Investigations: 3 Credits (3 Lec)**

() Spring, even years. Advanced topics in hydraulics and fluid mechanics.

**ECIV 531 River Modelling: 3 Credits (3 Lec)**

() Spring, odd years. Theory and practice of multi-dimensional open channel modelling including theory, field data collection, data management, modelling best practices, verification and validation.

**ECIV 544 Civil Engineering Computations: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 202 and M 274. (Sp) The focus of this course is to teach students to appreciate and use various computational tools to solve complex civil engineering problems. Specifically, this course will focus on the MATLAB programming language and will cover a comprehensive set of tools and methods available in this program. Elements learned in this program (logical functions, loops, matrices) will be extended to various other programs suitable for such analyses

**ECIV 554 Transportation Safety: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 350. () Spring, odd years. This course addresses safety of the highway system as related to design, construction, and operations. The course provides an overview of the various elements of the highway system namely, road users, vehicles, roadways, and environment as related to safety. Apart from the introduction, the course is structured in three distinct components that represent the sequential stages in highway life; i.e. design, construction, and operations

**ECIV 555 Survey Data Collection & Analysis: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: EGEN 350 or EIND 354. () No longer offered. This course introduces students to the principles and practice of survey data collection and analysis for transportation engineering and elevates students' ability to design and apply scalable approaches to analyze transportation-related data. Transportation survey design, implementation and analysis are covered. Methods and techniques for anticipating traffic events (crashes, congestion, etc.) are studied. Co-convened with ECIV 455

**ECIV 556 Traffic Flow Fundamentals: 3 Credits (3 Lec)**

PREREQUISITE: ECIV 350, EGEN 350 or STAT 332. () Spring, even years. This course covers traffic stream parameters, their relationships, and important analytical techniques in traffic engineering such as capacity analysis, queuing analysis, shockwave analysis, and traffic simulation. Topics covered are essential in understanding the behavior of vehicular traffic as a complex system

**ECIV 575 Research or Prof Paper/Project: 1-4 Credits (1-4 Other)**

PREREQUISITE: Graduate standing. (F, Sp, Su) A research or professional paper or project dealing with a topic in the field. The topic must have been mutually agreed upon by the student and his or her major adviser and graduate committee  
Repeatable up to 6 credits.

**ECIV 589 Graduate Consultation: 1-3 Credits (1-3 Other)**

PREREQUISITE: Master's standing and approval of the Dean of Graduate Studies. This course may be used only by students who have completed all of their course work (and thesis, if on a thesis plan) but who need additional faculty or staff time or help  
Repeatable up to 3 credits.

**ECIV 590 Master's Thesis: 1-10 Credits (1 Other)**

PREREQUISITE: Master's standing. Department of Civil Engineering  
Repeatable up to 99 credits.

**ECIV 591 Special Topics: 1-4 Credits (1-4 Lec)**

PREREQUISITE: Upper division courses and others as determined for each offering. On demand. Courses not required in any curriculum for which there is a particular one time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number  
Repeatable up to 12 credits.

**ECIV 592 Independent Study: 1-6 Credits (1-6 Other)**

PREREQUISITE: Graduate standing, consent of instructor, approval of Department Head and Dean of Graduate Studies. (F, Sp, Su) Directed research and study on an individual basis  
Repeatable up to 6 credits.

**ECIV 594 Seminar: 1 Credits (1 Other)**

PREREQUISITE: Final semester of MS program. Students participate in preparing and presenting discussion material  
Repeatable up to 4 credits.

**ECIV 598 Internship: 2 Credits (2 Other)**

An individual assignment arranged with an agency, business or other organizations to provide guided experience in the field.  
Repeatable up to 12 credits.

**ECIV 690 Doctoral Thesis: 1-10 Credits (1-10 Other)**

PREREQUISITE: Doctoral standing. Department of Civil Engineering  
Repeatable up to 99 credits.