

DEPARTMENT OF CIVIL ENGINEERING

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Civil engineering consists of the application of scientific principles to the design, construction, and maintenance of public and private works that constitute the infrastructure for human populations. From a historical aspect, the pyramids of Egypt, the water resources systems that supported the agricultural society of ancient Babylonia and Assyria, the public buildings of Greece and Rome, the roads that linked the Roman Empire, and the railroads and barge canals of the early United States were all civil engineering projects that served the people of their times. Today's civil engineers are still involved in building and maintaining the infrastructure necessary for modern society to function. A civil engineer may be involved in the design and construction of highways, bridges, buildings, water conveyance systems, water and wastewater treatment plants, dams, airports, and other constructed projects. Civil engineers may also be involved in planning for traffic controls, flood plain management, and water and air quality management. The graduates of civil engineering programs may work with consulting engineering firms, governmental agencies, construction contractors, or manufacturing industries.

In the foreseeable future, population growth and relocation should create a steady demand for infrastructure growth. The concept of environmentally sensitive and resource sustainable development is emerging as the tenet for future growth. Civil engineers will have to apply evolving technologies and develop innovative solutions to ensure wise stewardship of our limited natural resources. Students who enter civil engineering can anticipate a challenging and rewarding career.

Lower-division courses in civil engineering consist of a common core of basic courses in science, mathematics, and engineering required of most students within the college. Required course work in the junior and senior years provides the student with a broad background in civil engineering subjects while 18 credits of technical electives permit some specialization at the undergraduate level. For civil engineering student interest in geology, there is an option to complete a minor in Geologic Engineering.

The Department of Civil Engineering occupies the first floor of the Buchanan Engineering Laboratory Building with some additional office and laboratory space in the basement and on the second floor of the building. Maintenance and replacement of existing equipment is provided by funds from research projects, from alumni donations, from lab fees, and from state educational funds. Instructional and research equipment include modern computing and data acquisition equipment.

The department offers three graduate degree programs in civil engineering: (1) Master of Science (30 credits, with thesis), (2) Master of Engineering (33 credits, non-thesis), and (3) Doctor of Philosophy (in limited specialty areas). It also offers the Master of Engineering in Engineering Management and a Master of Science in Geologic Engineering. Course work requirements in each of the degree programs are relatively flexible depending on student interest and course availability. Financial assistance is available on a competitive basis in the form of instructional and graduate research assistantships. Students interested in graduate studies should select a specialty area in which they wish to study. Foreign students must have a TOEFL score of at least 550 for admission to any departmental graduate degree program.

Graduate study is offered with specialization in structures and structural mechanics, highway and pavement materials, soil mechanics, transportation, hydraulics and water resources, geological engineering and sanitary engineering. Interdisciplinary programs of study are encouraged for interested students. As examples, students specializing in sanitary engineering may do considerable work in chemical engineering or biochemistry, and specialization in soil mechanics may involve study in geology or mining engineering.

The mission of the Department of Civil Engineering is to provide a high quality education at both the undergraduate and graduate level, emphasizing the needs of Idaho and the region. The goals and objectives of the program include graduating students that will be: (1) Competent in the fundamentals of engineering, (2) Capable of designing and describing civil engineering systems and processes (3) Aware of the social and eco-

nomical implications of engineered projects, and (4) Responsible, ethical, and committed to life-long learning. Additionally, the department is committed to (1) maintaining experienced, professional instructors, modern facilities, and close interaction between the department and the professional engineering community in Idaho, (2) extending the knowledge base in civil engineering through research, continuing education, technology transfer, and professional practice, and (3) providing these services in the most cost effective manner for both the students and the taxpayers. Progress toward these goals and objectives is assessed by student performance on the nationally administered Fundamentals of Engineering Exam, exit interviews with graduating students, surveys of graduated students and their employers, and by an external advisory committee composed of practicing civil engineers from the state and the region.

The Bachelor of Science program in Civil Engineering is accredited by the Engineering Accreditation Commission of Accreditation Board for Engineering and Technology (ABET), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700.

Courses

See the course description section for courses in Civil Engineering (CE), Engineering Management (EM) and Geological Engineering (GeoE).

Civil Engineering Undergraduate Curricular Requirements

Civil Engineering (B.S.C.E.)

To graduate in this program, a minimum grade of C must be earned in all engineering, mathematics, and science courses used to satisfy the curriculum.

Any student majoring in civil engineering may accumulate no more than 14 credits of D or F in mathematics, science, technical elective, or engineering courses that are used to satisfy graduation requirements. Included in this number are multiple repeats of a single class or single repeats in multiple classes and courses transferred from other institutions. A warning will be issued in writing to students who have accumulated 7 credits of D or F in mathematics, science, technical elective, or engineering classes used to satisfy curricular requirements.

Required course work includes the university requirements (see regulation J-3) and:

CE 115	Introduction to Civil Engineering (1 cr)
CE 211	Engineering Surveying (3 cr)
CE 215	Civil Engineering Analysis and Design (3 cr)
CE 322	Hydraulics (3 cr)
CE 325	Fundamentals of Hydrologic Engineering (3 cr)
CE 330	Fundamentals of Environmental Engineering (3 cr)
CE 342	Theory of Structures (3 cr)
CE 357	Properties of Construction Materials (4 cr)
CE 360	Fundamentals of Geotechnical Engineering (4 cr)
CE 372	Fundamentals of Transportation Engineering (4 cr)
CE 491	Civil Engineering Professional Seminar (1 cr)
CE 494	Senior Design Project (3 cr)
Chem 111	Principles of Chemistry I (4 cr)
Engr 317	Technical Writing (3 cr)
Engr 105	Engineering Graphics (2 cr)
Engr 210	Engineering Statics (3 cr)
Engr 220	Engineering Dynamics (3 cr)
Engr 335	Engineering Fluid Mechanics (3 cr)
Engr 350	Engineering Mechanics of Materials (3 cr)
Engr 360	Engineering Economy (2 cr)
Math 170	Analytic Geometry and Calculus (4 cr)
Math 175	Analytic Geometry and Calculus II (4 cr)
Math 275	Analytic Geometry and Calculus III (3 cr)
Math 310	Ordinary Differential Equations (3 cr)
Phys 211	Engineering Physics I (3 cr)
Stat 301	Probability and Statistics (3 cr)

One of the following (3 cr):

AmSt 301	Studies in American Culture (3 cr)
Phil 103	Ethics (3 cr)

One of the following (3-4 cr):

Econ 201	Principles of Macroeconomics (3 cr)
Econ 202	Principles of Microeconomics (3 cr)
Econ 272	Foundations of Economic Analysis (4 cr)

One of the following (3 cr):

Engr 240	Introduction to Electrical Circuits (3 cr)
Engr 320	Engineering Thermodynamics and Heat Transfer (3 cr)

Two of the following (8-9 cr):

Biol 115	Cells and the Evolution of Life (4 cr)
Chem 112	Principles of Chemistry II and Lab (5 cr)*
Phys 212, Phys 212L	Engineering Physics II and Lab (4 cr)*
Geol 111, Geol 111L	Physical Geology for Science Majors and Lab (4 cr)
MABB 154, MABB 155	Introductory Microbiology and Lab (4 cr)

*Note: Students may use Chem 112 or Phys 212/212L, but not both.

Technical electives. To ensure sufficient breadth, technical electives must include at least 15 credits from at least three of the following five groups (21 cr):

Environmental:

CE 431	Design of Water and Wastewater Systems I (3 cr)
CE 432	Design of Water and Wastewater Systems II (3 cr)
CE 433	Water Quality Management (3 cr)

Geotechnical:

CE 460	Geotechnical Engineering Design (3 cr)
GeoE 436	Geological Engineering Analysis and Design (3 cr)

Hyd/Water Resources:

CE 421	Engineering Hydrology (3 cr)
CE 422	Hydraulic Design (3 cr)
CE 428	Open Channel Hydraulics (3 cr)

Structures:

CE 441	Reinforced Concrete Design (3 cr)
CE 444	Steel Design (3 cr)
CE 445	Matrix Structural Analysis (3 cr)

Transportation:

CE 474	Traffic Systems Design (3 cr)
CE 475	Pavement Design and Evaluation (3 cr)

Other CE 400 level classes (except CE 411), or approved alternatives, may be used to complete the required 21 cr of tech electives.

Courses to total 128 credits for this degree, not counting math below 170, English below 102, and any classes needed to remove deficiencies.

Civil Engineering Academic Minor Requirements

Geological Engineering Minor

CE 360	Fundamentals of Geotechnical Engineering (4 cr)
CE 460	Geotechnical Engineering Design (3 cr)
Geol 111, Geol 111L	Physical Geology for Science Majors and Lab (4 cr)
Geol 345	Structural Geology (3-4 cr)
Geol 422	Principles of Geophysics (4 cr)
GeoE 407	Rock Mechanics (3 cr)
GeoE 436	Geological Engineering Analysis and Design (3 cr)
Hydr 409	Quantitative Hydrogeology (3 cr)
Approved technical elective in the geotechnics area (3 cr)	

Courses to total 20 credits for this minor

Civil Engineering Graduate Academic Certificates Requirements

Applied Geotechnics Graduate Academic Certificate

Note: A grade of 'B' or higher is required in all coursework for this academic certificate.

GeoE 407	Rock Mechanics (3 cr)
GeoE 436	Geological Engineering Analysis and Design (3 cr)

Electives (6 cr):

GeoE 428	Geostatistics (3 cr)
GeoE 465	Excavation and Materials Handling (3 cr)
GeoE 517	Tunnel Design and Construction (3 cr)
GeoE 535	Seepage and Earth Dams (3 cr)

Courses to total 12 credits for this certificate

Structural Engineering Graduate Academic Certificate

Note: A grade of 'B' or higher is required in all coursework for this academic certificate.

CE 546	Finite Element Analysis (3 cr)
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One course from the following (3 cr):

CE 542	Advanced Design of Steel Structures (3 cr)
CE 547	Advanced Reinforced Concrete (3 cr)

Electives (6 cr):

CE 504	Special Topics (3 cr)
CE 510	Advanced Mechanics of Materials (3 cr)
CE 541	Reliability of Engineering Systems (3 cr)
CE 542	Advanced Design of Steel Structures (3 cr)
CE 543	Dynamics of Structures (3 cr)
CE 545	Matrix Structural Analysis (3 cr)
CE 547	Advanced Reinforced Concrete (3 cr)

Electives may include one of the following:

CE 521	Sedimentation Engineering (3 cr)
CE 561	Engineering Properties of Soils (3 cr)
CE 562	Advanced Foundation Engineering (3 cr)
CE 566	Geotechnical Earthquake Engineering (3 cr)
CE 575	Advanced Pavement Design and Analysis (3 cr)

Courses to total 12 credits for this certificate

Water Resources Engineering Graduate Academic Certificate

Note: A grade of 'B' or higher is required in all coursework for this academic certificate.

CE 428	Open Channel Hydraulics (3 cr)
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One course from the following (3 cr):

CE 519	Fluid Transients (3 cr)
CE 521	Sedimentation Engineering (3 cr)

Electives (6 cr):

CE 421	Engineering Hydrology (3 cr)
CE 520	Fluid Dynamics (3 cr)
CE 528	Stochastic Hydrology (3 cr)
CE 533	Water Quality Management (3 cr)
CE 546	Finite Element Analysis (3 cr)
Engr 428	Numerical Methods (3 cr)

Courses to total 12 credits for this certificate

Civil Engineering Graduate Degree Programs

Graduate study is offered with specialization in the following subdisciplines of civil engineering: hydraulics and water resources engineering, environmental and sanitary engineering, structural engineering and structural mechanics, geotechnical engineering, and transportation engineering.

Master's Degrees. In addition to meeting the general requirements of the College of Graduate Studies stated in this catalog, master's degree students are required to complete at least 12 credits of 500s level courses having a CE prefix, not including CE 500, CE 502, CE 503, CE 597, CE 598, and CE 599. Master's degree students are required to complete at least 12 credits in courses associated with one of the subdisciplines of civil engineering listed above. On their plan of study, candidates are restricted to a maximum of 6 credits of coursework with a grade of 'C'.

An approved thesis is required for Master of Science degrees. A maximum of 6 credits of CE 500, Master's Research and Thesis, can be used to fulfill M.S. degree requirements.

A minimum of 33 credits is required for the Master of Engineering degree. A thesis is not required and credit is not given for CE 500. A maximum of 3 credits of CE 502, Directed Study, can be used to satisfy M.Engr. degree requirements. M.Engr. students are required to demonstrate the ability to write a technical paper or report.

A final comprehensive examination conducted by the student's committee is required for master's degrees.

Applicants for admission to the master's degree programs generally will have a B.S. degree in civil engineering. Graduate degree applicants not holding B.S. degrees in civil engineering are required to show evidence of completing the following undergraduate coursework: mathematics through differential equations, and one semester each of chemistry, physics, and engineering statics. Once admitted, additional preparatory coursework will be determined by the student's advisory committee and/or as pre-requisites to courses listed in the student's study plan

Doctor of Philosophy. Major in Civil Engineering. Persons interested in pursuing a doctoral degree must contact a correspondent in the department well in advance of admission to the Graduate College. Preliminary screening of candidates and program planning for those admitted are essential features of the Ph.D. program. Programs are offered with specialization in the following general areas: (1) water resources and hydraulics; (2) structures, structural mechanics, and construction materials; (3) geotechnical engineering with a major in soil mechanics; (4) transportation engineering; and (5) environmental engineering. The qualifying examination is written and/or oral, and the preliminary examination is written and oral.

CIVIL ENGINEERING COURSES

Richard J. Nielsen, Dept. Chair, Dept. of Civil Engineering (104 Buchanan Engr. Lab. 83844-1022; phone 208/885-6782).

Prerequisites: All prerequisites for Civil Engineering (CE) courses must be completed successfully with a grade of C or better.

CE 115 Introduction to Civil Engineering (1 cr)

Introduction to civil engineering problem solving skills, development of software use skills, graphical analysis, data analysis, and oral and written communication skills. One weekly two hour laboratory with up to 3 out-of-class activities.

Prereq: Major in civil engineering

CE 200 (s) Seminar (cr arr)

CE 203 (s) Workshop (cr arr)

CE 204 (s) Special Topics (cr arr)

CE 211 Engineering Surveying (3 cr)

Theory of measurements, basic equations for survey computations, types of distribution of errors, topographical and land surveying introduction to geographic information systems and global positioning systems, coordinate geometry and coordinate transformations, site engineering projects using land development software, application of surveying methods to construction; site engineering, and civil engineering projects surveying instruments. Two lec and one 3-hr lab a week; periodic field data collection and one or two field trips.

Prereq: Math 143 or Math 170 or Math 175, and Engr 105. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 215 Civil Engineering Analysis and Design (3 cr)

Application of basic science, mathematics, and fundamental engineering principles to solution of civil engineering design problems; use of structured programming concepts in design; develop oral and written communication skills.

Prereq: CE 115, Engr 105, and Math 170. A minimum grade of 'C' or better is required for all pre/coreqs.

Coreq: Phys 211/211L. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 299 (s) Directed Study (cr arr)

CE 322 Hydraulics (3 cr)

Applied principles of fluid mechanics; closed conduit flow, hydraulic machinery, open channel flow; design of hydraulic systems. Laboratory exercises on closed conduit flow, hydraulic machinery, open channel flow and mixing process. Three lec a week and 4-6 labs a semester.

Prereq: CE 215, Math 310, Phys 211/211L, Engr 220 and Engr 335. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 325 Fundamentals of Hydrologic Engineering (3 cr)

Same as BAE 355. Principles of hydrologic science and their application to the solution of hydraulic, hydrologic, environmental, and water resources engineering problems.

Prereq: Math 310, Stat 301, and Engr 335. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 330 Fundamentals of Environmental Engineering (3 cr)

Principles of engineered environmental systems, including physical, chemical, and microbiological processes; types and effects of pollutants; regulations; treatment of water, wastewater, sludges, and solid waste; control of air and agricultural pollution. Three lec and one 3-hr lab a wk.

Prereq: Engr 335, Chem 111, CE 215 and Math 310. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 342 Theory of Structures (3 cr)

Stresses and strains in statically determinate and indeterminate beam, truss, and rigid frame structures; effects of moving loads; matrix displacement method. Two lec and one 3-hr lab a wk.

Prereq: Engr 350, Math 275, Math 310, and Phys 211/211L. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 357 Properties of Construction Materials (4 cr)

Principles of construction materials, composition, physical and mechanical properties, test methods, data analysis and interpretations, and re-

port writing; materials covered are aggregates, cements, concretes, metals, wood, and composites. Three lec and two hrs of lab.

Prereq: CE 215, Engr 350, Math 310. A minimum grade of 'C' or better is required for all pre/coreqs.

Coreq: Stat 301. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 360 Fundamentals of Geotechnical Engineering (4 cr)

Soil composition, descriptions, and classification systems; permeability and seepage; capillarity and suction; total, effective, and neutral stresses, compression and volume changes; shear strength; compaction. Three lectures, and 2 hours of lab a week.

Prereq: CE 215, Engr 335, Engr 350, and Math 310. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 372 Fundamentals of Transportation Engineering (4 cr)

Intro to planning, design, and operation of highway and traffic, public transportation, and airport systems. Three lec and one 3-hr lab a wk; periodic field data collection and one or two field trips.

Prereq: Stat 301 and CE 211. A minimum grade of 'C' or better is required for all pre/coreqs.

Coreq: Engr 317. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 400 (s) Seminar (cr arr)

CE 403 (s) Workshop (cr arr)

CE 404 (s) Special Topics (cr arr)

CE 411 Engineering Fundamentals (1 cr)

Review of basic engineering and science material covered in Fundamentals of Engineering exam. Offered for the nine to ten week period prior to the exam date. Graded P/F.

Prereq: Senior standing or Permission

CE 421 Engineering Hydrology (3 cr)

Same as BAE ID451. Hydrologic design including: statistical methods, rainfall analysis and design storm development, frequency analysis, peak discharge estimation, hydrograph analysis and synthesis, flow routing, and risk analysis.

Prereq: CE 325 or BAE 355. A minimum grade of 'C' or better is required for all pre/coreqs.

CE J422/J522 Hydraulic Structures Analysis and Design (3 cr)

Hydraulic design and stability analysis of hydraulic structures, such as dams, weirs, spillways, stilling basins, culverts, levees, fish ladders etc. Project oriented problems. Extra design projects or different design projects for grad cr. One field trip. CE 422 is a cooperative course available to WSU degree-seeking students.

Prereq: CE 322 or Equivalent, Engr 360, or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 428 Open Channel Hydraulics (3 cr)

Same as BAE 458. Hydraulics of uniform and varied flow in open channels with fixed and movable beds. Recommended Preparation: CE 322. Cooperative: open to WSU degree-seeking students.

CE 431 Design of Water and Wastewater Systems I (3 cr)

Application of fundamental engineering science to the design of systems for the treatment of domestic and industrial water supplies; treatment and re-use of domestic sewage and industrial wastes. Three lec a wk.

Prereq: CE 322, CE 330, or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE J432/J532 Design of Water and Wastewater Systems II (3 cr)

Application of unit operations and processes to design of integrated wastewater treatment systems; critical analysis of existing designs. Additional projects/assignments reqd for grad cr. CE 532 is a cooperative course available to WSU degree-seeking students.

Prereq: CE 431. A minimum grade of 'C' or better is required for all pre/coreqs.

CE J433/J533 Water Quality Management (3 cr)

Physical, chemical, and biological techniques for analysis of water quality management problems; development of design criteria for corrective systems. Additional projects/assignments reqd for grad cr.

Prereq: Permission

CE 441 Reinforced Concrete Design (3 cr)

Strength design method in accordance with latest ACI code. Two lec and one 2-hr lab a wk.

Prereq: CE 342. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 444 Steel Design (3 cr)

Structural steel design using latest AISC specifications. Two lec and one 2-hr lab a wk.

Prereq: CE 342. A minimum grade of 'C' or better is required for all pre/coreqs.

CE J445/J545 Matrix Structural Analysis (3 cr)

Formulation of the analysis of trusses, beams, and frames using the stiffness method of matrix structural analysis; development of element properties, coordinate transformations, and global analysis theory; special topics such as initial loads, member and joint constraints, and non-linear analysis. Special project demonstrating mature understanding of materials reqd for grad cr.

Prereq: CE 342 or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 460 Geotechnical Engineering Design (3 cr)

Applications of soil mechanics in design of shallow and deep foundations, earth retaining structures, excavations, and soil exploration.

Prereq: CE 360; and CE 441 or CE 444; or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 473 Highway Design (3 cr)

Theory and practice in highway design, highway functional classification concepts, design controls and criteria, geometric design of highways and streets, cross section and roadside design, and highway safety manual applications.

Prereq: CE 211. A minimum grade of 'C' or better is required for all pre/coreqs.

Coreq: CE 372. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 474 Traffic Systems Design (3 cr)

Analysis and design of network traffic systems; system evaluation using computer optimization and simulation; development and testing of alternative system design. Two lec and one 3-hr lab a wk; field data collection and field site visits. Cooperative: open to WSU degree-seeking students.

Prereq: CE 372 or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 475 Pavement Design and Evaluation (3 cr)

Pavement design processes; stress-strain analysis in multi-layer elastic system; materials selection and characterization methods; traffic loads, design methods for flexible and rigid pavements; performance evaluation of existing pavements; condition survey and ratings; introduction to pavement maintenance and rehabilitation techniques.

Prereq: CE 357 or Equivalent, or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 482 Project Engineering (3 cr)

Modern project engineering techniques for planning, scheduling, and controlling typical engineering and construction projects; linear programming and other optimization techniques as applied to resource allocation; microcomputer applications are emphasized and appropriate software used throughout the course.

Prereq: Stat 251, Stat 301, or Equivalent, and Senior standing or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 484 Engineering Law and Contracts (3 cr)

Project engineering techniques for planning, scheduling, and controlling typical engineering and construction projects. Contract law and application to engineering services agreements and construction contracts; preparing technical specifications, torts, professional liability, and alternate dispute resolution.

Prereq: Senior standing in engineering

CE 491 Civil Engineering Professional Seminar (1 cr)

Employment and technical topics; preparation and presentation of professional paper. Course to be taken in last semester before graduation. Graded P/F.

Prereq: Senior standing in Civil Engineering.

CE 492 (s) Professional Society Project (1 cr, max 2)

May be used as a technical elective by CE majors. Active participation in a student project sponsored by one of the professional engineering societies; students schedule, manage, and complete the project, make written and oral presentations, and present the project results to the sponsoring professional engineering society.

Prereq: Junior standing in Civil Engineering and Permission

CE 494 Senior Design Project (3 cr)

Comprehensive civil engineering design project. Requires integration of skills acquired in civil engineering elective courses, written reports, and oral presentations.

Prereq: Senior standing in Civil Engineering and Permission

CE 499 (s) Directed Study (cr arr)**CE 500 Master's Research and Thesis (cr arr)****CE 501 (s) Seminar (cr arr)**

Conferences and reports on current developments.

CE 502 (s) Directed Study (cr arr)**CE 503 (s) Workshop (cr arr)****CE 504 (s) Special Topics (cr arr)****CE 507 River Restoration (3 cr)**

This course focuses on the principles and practices used in river restoration. The potential assumptions and errors with common restoration methodologies and possible ways to improve such channel designs are discussed. A number of case studies are used to evaluate the success of various restoration techniques. The course includes homework sets and individual projects and has a mandatory field trip to a local restored site. Recommended classes to take prior to this include at least one of the following: CE 535, CE 322, CE 428, or CE 520.

Prereq: Engr 335 or Instructor Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 510 Advanced Mechanics of Materials (3 cr)

See ME 539. Cooperative: open to WSU degree-seeking students.

CE 512 Advanced Topics in Waste Management and Treatment (3 cr)

Modeling, analysis, and design of advanced and emerging engineering technologies and processes for waste management/treatment and resource recovery.

Prereq: Instructor Permission

CE 516 River Restoration (3 cr)

This course focuses on the principles, assumptions and practices used in river restoration. The use of channel form, channel classification, reference reaches, sediment transport equations, hydraulic structures, 1-D and 2-D flow models, and aquatic habitat modeling to design restoration projects are discussed. The course also includes topics such as adaptive management, restoration evaluation and monitoring, basic ecological design goals, and a number of local case studies. The course has a mandatory field trip to a local restored site. Recommended classes to take prior to this include at least one of the following: CE 535, CE 322, CE 428, or CE 520.

Prereq: Engr 335 or Instructor Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 519 Fluid Transients (3 cr)

Same as ME 519. Development of concepts and modeling techniques for unsteady flow of liquid and gas in piping systems; extensive computer programming used to develop tools for analysis, design, and control of transients. (Alt/yrs)

Prereq: Math 310 and Engr 335. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 520 Fluid Dynamics (3 cr)

See ME J420/J520.

CE 521 Sedimentation Engineering (3 cr)

Intro to river morphology and channel responses; fluvial processes of erosion, entrainment, transportation, and deposition of sediment. Cooperative: open to WSU degree-seeking students.

Prereq: CE 428 or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 522 Hydraulic Structures Analysis and Design (3 cr)

See CE J422/J522.

CE 523 Water Resources Systems (3 cr)

Concepts in water development; coordination of development of other natural resources; systems approach and optimization techniques.

Prereq: Permission

CE 526 Aquatic Habitat Modeling (3 cr)

The course objective is to learn the underlying principles of all components required for aquatic habitat modeling, to be able to perform such projects in riverine ecosystems including project design, data collection, data analysis and interpretation of the results and to learn the use of computational aquatic habitat models. Students will be working on their own modeling projects using the simulation model CASIMiR.

Prereq: CE 322 and CE 325 or BAE 355; or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 528 Stochastic Hydrology (3 cr)

Analyses and evaluation of hydrologic data and time series; application of stochastic models to data generation and record extension (daily and storm precipitation, monthly and annual streamflows); regression and autoregression analyses; extensive computer applications for data analysis and synthesis.

Prereq: CE 325, introductory statistics course. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 531 Environmental Engineering Unit Operations (3 cr)

Analysis and design of physical and chemical operations of water and waste treatment; flow models, sedimentation, flocculation, filtration, and water conditioning. Cooperative: open to WSU degree-seeking students.

Prereq: Permission

CE 532 Design of Water and Wastewater Systems II (3 cr)

See CE J432/J532.

CE 533 Water Quality Management (3 cr)

See CE J433/J533.

CE 534 Environmental Engineering Unit Processes (3 cr)

Aeration system design, biological oxidations, growth kinetics, process design of suspended growth and fixed film aerobic and anaerobic systems, biological nutrient removal, land treatment systems. Cooperative: open to WSU degree-seeking students.

Prereq: CE 431 or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 535 Fluvial Geomorphology and River Mechanics (3 cr)

Hydraulic and morphologic processes of rivers. Drainage network development, channel hydraulics and shear stress partitioning via boundary layer theory, hydraulic geometry and cross-sectional form, sediment transport and bed material sampling, reach-scale morphologies and processes from headwater streams to lowland rivers, physical processes of forest rivers, sediment budgets, and river valley evolution. Field exercises emphasize quantitative analysis of fluvial processes and channel form, acquisition of field skills (measuring hydraulic and geomorphic variables, topographic surveying), and scientific writing. (Alt/yrs)

Prereq: CE 428 or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 536 Hydropower Systems (3 cr)

Design, construction and operation of low-head, medium and high-head hydropower plants, including run-of-river, storage and pumped storage plants. Design and analysis of hydraulic components, economic analysis, environmental aspects and low impact hydro schemes. (Alt/yrs, Fall only)

Prereq: CE 322, CE 325 or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 541 Reliability of Engineering Systems (3 cr)

Same as ME 583. Fundamentals of reliability theory, system reliability analysis including common-mode failures and fault tree and event tree analysis, time-dependent reliability including testing and maintenance, propagation of uncertainty, human reliability analysis, practical applications in component and system design throughout the semester. Cooperative: open to WSU degree-seeking students.

Prereq: Permission

CE 542 Advanced Design of Steel Structures (3 cr)

Plate girder design; local and global buckling; plastic collapse analysis; shear and moment-resisting connections; eccentrically-loaded connections. Cooperative: open to WSU degree-seeking students.

Prereq: CE 444 or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 543 Dynamics of Structures (3 cr)

Equations of motion, free vibration, damping mechanisms, harmonic, impulse, and seismic loading; shock and seismic response spectra, time and frequency domain analysis, modal analysis, structural dynamics in building codes. Cooperative: open to WSU degree-seeking students.

CE 545 Matrix Structural Analysis (3 cr)

See CE J445/J545.

CE 546 Finite Element Analysis (3 cr)

Same as ME 549. Formulation of theory from basic consideration of mechanics; applications to structural engineering, solid mechanics, soil and rock mechanics; fluid flow. Cooperative: open to WSU degree-seeking students.

Prereq: ME 341 or CE 342. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 547 Advanced Reinforced Concrete (3 cr)

Composite design; slab design; limit state design; footings; retaining walls; deep beams; brackets and corbels; torsion; seismic design; shear walls. Cooperative: open to WSU degree-seeking students.

Prereq: CE 441. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 550 Experimental Methods in Fluid Dynamics(3 cr)

The objective of this course is to develop the knowledge and skills to be able to design and perform fluid dynamics experiments (and experiments in related areas) and to interpret and report the results. Learn the words, the concepts, and experimental skills in areas including dimensional analysis and scaling of experiments, flow visualization, velocity and flow rate measurements, turbulence measurements, and sediment sizing and transport measurements. Additional projects/assignments reqd for grad cr. One 1-1/2 hr lec and one 3-hr lab a wk. Recommended Preparation: Engr 317 and Engr 335.

CE 554 Environmental Hydrodynamics (3 cr)

The course analyzes solute transport and mixing in rivers. It provides the derivation and analysis of the equations governing solute mixing and transport and shows the connection between mixing and flow field. It presents molecular and turbulent diffusion, dispersion, vertical, lateral, and longitudinal mixing, and the effects of river irregularities and curved channels. The course includes individual projects.

Prereq: CE 428 or permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 556 Properties of Highway Pavement Materials (3 cr)

Physical and mechanical properties of asphalt and Portland cement concrete materials; design of asphalt concrete mixes; introduction to viscoelastic theory; characterization methods, emphasizing fatigue, rutting and thermal cracking; modification and upgrading techniques. Three 1-hr lec a wk and variable number of lab hrs for demonstration. Cooperative: open to WSU degree-seeking students.

Prereq: CE 357 or Equivalent, or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 561 Engineering Properties of Soils (3 cr)

Physical properties, compressibility and consolidation, shear strength, compaction, saturated and unsaturated soils, laboratory and field methods of measurement, relations of physical and engineering properties, introduction to critical-state soil mechanics. Cooperative: open to WSU degree-seeking students.

Prereq: CE 360. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 562 Advanced Foundation Engineering (3 cr)

Interpretation of in-situ tests for foundation design parameters, bearing capacity and settlement of axially loaded piles, pile groups, and drilled shafts, pile dynamics, laterally loaded deep foundations, downdrag and uplift of deep foundations, foundation load and integrity testing methods and data interpretation, mat foundations. Cooperative: open to WSU degree-seeking students.

Prereq: CE 360 or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 563 Seepage and Slope Stability (3 cr)

Same as GeoE 535. Principles governing the flow of water through soils; mechanics of stability analysis of slopes, landslides, and embankments for soil and rock masses; probabilistic analyses; stabilization methods. Cooperative: open to WSU degree-seeking students. (Alt/even yrs, Spring only)

Prereq: CE 360 or GeoE 436; or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 566 Geotechnical Earthquake Engineering (3 cr)

Faulting and seismicity; site response analysis; probabilistic seismic hazard assessment; dynamic soil properties; influence of soil on ground shaking; response spectra; soil liquefaction; seismic earth pressures; seismic slope stability; earthquake resistant design. Cooperative: open to WSU degree-seeking students.

Prereq: CE 360 or Equivalent, or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 571 Traffic Flow Theory (3 cr)

Introduction to elements of traffic flow theory including principles of traffic stream characteristics, capacity, queuing theory, and shock waves; application of traffic flow theory to freeway and arterial traffic flow problems. Cooperative: open to WSU degree-seeking students. (Alt/yrs)

Prereq: Permission

CE 572 Intersection Traffic Operations (3 cr)

Application of traffic simulation models to the design and operations of traffic facilities, including intersection, arterials; assessment and design of traffic signal timing strategies. Cooperative: open to WSU degree-seeking students. (Alt/yrs)

Prereq: Permission

CE 573 Transportation Planning (3 cr)

Concepts and methods of transportation planning, including network modeling, travel demand forecasting, and systems evaluation of multi-modal transportation systems. Cooperative: open to WSU degree-seeking students. (Alt/yrs)

Prereq: Permission

CE 574 Public Transportation (3 cr)

Concepts and principles of planning and operations of public transportation systems, including bus transit, rail transit, and paratransit modes. Cooperative: open to WSU degree-seeking students. (Alt/yrs)

Prereq: Permission

CE 575 Advanced Pavement Design and Analysis (3 cr)

Design of new and rehabilitated asphalt and Portland cement concrete pavements; mechanistic-empirical design procedures; performance models; deflection-based structural analysis, overlay design, environmental effects; long-term pavement performance (LTPP), and introduction to research topics in pavement engineering. Cooperative: open to WSU degree-seeking students.

Prereq: CE 475 or Equivalent, or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 576 Highway Design and Traffic Safety (3 cr)

Geometric design of highways as related to operation and safety. Analysis of highway design alternatives and control strategies with respect to accident probabilities. Statistical models for safety analysis. Accident countermeasure selection and evaluation methodology. Risk management.

Prereq: Permission

CE 577 Pavement Management and Rehabilitation (3 cr)

Overview of Pavement Management Systems; PMS project and network levels; serviceability concepts and performance models; PMS data needs; rehabilitation and maintenance strategies; life cycle cost analysis; implementation of PMS in design, construction, maintenance, and research; examples of working PMS; maintenance and rehabilitation of asphalt and concrete pavements. Cooperative: open to WSU degree-seeking students.

Prereq: CE 475 or Equivalent, or Permission. A minimum grade of 'C' or better is required for all pre/coreqs.

CE 578 Highway Traffic Operations (3 cr)

Theory of two-lane highway and freeway operations, application of traffic simulation models for the design and operations of highway, development and assessment of freeway management and control strategies including Intelligent Transportation Systems applications, field data collection and analysis. (Alt/yrs)

Prereq: Permission

CE 597 (s) Practicum (cr arr)**CE 598 (s) Internship (cr arr)****CE 599 (s) Non-thesis Master's Research (cr arr)**

Research not directly related to a thesis or dissertation.

Prereq: Permission

CE 600 Doctoral Research and Dissertation (cr arr)

GEOLOGICAL ENGINEERING COURSES

Richard J. Nielsen, Dept. Chair, Dept. of Civil Engineering (104 Buchanan Engr. Lab. 83844-1022; phone 208/885-6782).

GeoE 403 (s) Workshop (cr arr)

GeoE 404 (s) Special Topics (cr arr)

GeoE 407 Rock Mechanics (3 cr)

Mechanical properties of rocks and rock masses; lab and insitu techniques to estimate strength, stress distribution, and deformation behavior in rock masses; application of analytical tools such as the finite element method to design stable excavations and support systems in rock.

Prereq: Engr 350

GeoE 428 Geostatistics (3 cr)

Same as Stat 428. WSU Geol and Stat 428. Applications of random variables and probability in geologic and engineering studies; regression, regionalized variables, spatial correlation, variograms, kriging, and simulation. Recommended Preparation: Stat 301. Cooperative: open to WSU degree-seeking students.

GeoE 436 Geological Engineering Analysis and Design (3 cr)

Geological engineering analysis and design methods, including data collection, stability analysis, and ground reinforcement techniques; individual and teamwork approaches to formulation and solving geological engineering problems. One 1-day field trip.

Prereq: CE 360 or graduate standing

GeoE 465 Excavation and Materials Handling (3 cr)

Principles of excavation design and handling of earth materials related to construction projects, quarries, and mines; blasting, excavation planning and scheduling, equipment selection and replacement, cost estimating, geographic information and management information systems. Computerized design using Gemcom and/or other appropriate software.

Prereq: CE 211 or Permission

GeoE 499 (s) Directed Study (cr arr)

GeoE 500 Master's Research and Thesis (cr arr)

GeoE 501 (s) Seminar (cr arr)

GeoE 502 (s) Directed Study (cr arr)

GeoE 503 (s) Workshop (cr arr).

GeoE 517 Tunnel Design and Construction (3 cr)

Geotechnical considerations for tunneling, drilling and blasting, TBM, ground support, haulage, ventilation, water handling, and trenchless technology. Application of analytical techniques such as the finite element method to design stable underground structures and support systems.

Prereq: GeoE 407 or Permission

GeoE 535 Seepage and Slope Stability (3 cr)

See CE 563. (Alt/even yrs, Spring only)

GeoE 598 (s) Internship (cr arr)

GeoE 599 (s) Non-thesis Master's Research (cr arr)

Research not directly related to a thesis or dissertation.

Prereq: Permission

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