CIVIL AND ENVIRONMENTAL ENGINEERING

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COLLEGE OF ENGINEERING

Bravo, **Rolando**, Associate Professor, Ph.D., University of Houston, 1990; 1991. Surface and subsurface hydrology, hydraulics and fluid mechanics.

Chevalier, **Lizette R.**, Associate Professor and *Chair*, Ph.D., Michigan State University, 1994; 1995. Environmental restoration of groundwater aquifers, experimental investigation of immiscible flow, and numerical modeling of subsurface transport.

Cook, **Echol E.**, Professor, *Emeritus*, Ph.D., Oklahoma State University, 1970; 1971. Biological waste treatment, fixed bed reactors, solid waste disposal.

Craddock, **James N.**, Associate Professor, Ph.D., University of Illinois, 1979; 1980. Solid mechanics, stress analysis; computational mechanics, composite materials.

Davis, **Philip K.**, Professor, *Emeritus.* Ph.D., University of Michigan, 1963; 1964.

DeVantier, **Bruce A.**, Associate Professor, Ph.D., University of California-Davis, 1983; 1983. Water quality modeling, sediment transport, turbulence modeling, finite element methods.

Evers, **James L.**, Associate Professor, *Emeritus*, Ph.D., University of Alabama, 1969; 1969.

Hsiao, **J. Kent**, Assistant Professor, Ph.D., University of Utah— Salt Lake City, 2000; 2001. Structural earthquake engineering, structural reliability, structural design of buildings and bridges using steel, reinforced or prestressed concrete, masonry, and wood.

Kassimali, **Aslam**, Professor, Ph.D., University of Missouri, 1976; 1980. Structural engineering, nonlinear structural analysis, structural dynamics and stability.

Kumar, Sanjeev, Associate Professor, Ph.D., University of Missouri-Rolla, 1996; 1998. Dynamic soil-structure interaction, piles under lateral loads, settlement prediction of landfills, hydraulic conductivity of clay barriers, seismic analysis and design of landfills, ground motion amplification in soils, liquefaction of silts and sands and machine foundations.

Marikunte, **Shashi S.**, Assistant Professor, Ph.D., Michigan State University—East Lansing, 1992; 2001. Structural analysis, reinforced/prestressed concrete and structural steel design, construction materials, fiber reinforced cement composites.

Nicklow, John W., Associate Professor, Ph.D., Arizona State University, 1998; 1998. Water resources and hydraulic engineering, application of operations research to water resources systems, sediment transport, applied hydrology.

Nowacki, **C. Raymond**, Associate Professor, *Emeritus,* Ph.D., University of Illinois, 1965; 1963.

Puri, **Vijay K.**, Professor, Ph.D., University of Missouri-Rolla, 1984; 1986. Geotechnical engineering, soil dynamics, machine foundations, liquefaction of soils.

Ray, **Bill T.**, Associate Professor, Ph.D., University of Missouri-Rolla, 1984; 1985. Chemical and biological treatment, fixed-film reactors, residuals management, toxic waste treatment.

Rubayi, **Najim**, Professor, *Emeritus,* Ph.D., University of Wisconsin, 1966; 1966.

Sami, **Sedat**, Professor, *Emeritus,* Ph.D., University of Iowa, 1966; 1966.

Yen, **Max Shing-Chung**, Professor, Ph.D., Virginia Polytechnic Institute, 1984; 1984. Composite materials, experimental mechanics, solid mechanics, and structural dynamics

Master of Science Degree in Civil Engineering

Graduate work leading to the Master of Science degree in civil engineering is offered by the College of Engineering. The program is designed to provide advanced study in the areas of environmental engineering, geotechnical engineering, hydraulic engineering and water resources, structural engineering, fluid mechanics, solid mechanics and engineering materials.

Admission

Students seeking admission to the graduate program in civil engineering must meet the admission standards set by the Graduate School and have a bachelor's degree in engineering or its equivalent. A student whose undergraduate training is deficient may be required to take coursework without graduate credit.

A non-refundable application fee of $30.00 must be submitted with the application. Attach your money order, payable to Southern Illinois University, to the top of the application form. Do not send cash. Only money orders payable to United States banks will be accepted.

Requirements

A graduate student in civil engineering is required to develop a program of study with a graduate adviser and establish a graduate committee of at least three members at the earliest possible date. Each student majoring in civil engineering may, with the approval of the graduate committee, also take courses in other branches of engineering or in areas of science and business, such as physics, geology, chemistry, mathematics, life science, administrative sciences, or computer science.

For a student who wishes to complete the requirements of the master's degree with a thesis, a minimum of thirty semester hours of acceptable graduate credit is required. Of this total, eighteen semester hours must be earned in the

Civil and Environmental Engineering Department. Each candidate is also required to pass a comprehensive examination covering all of the student's graduate work including thesis.

If a student prefers the non-thesis option, a minimum of thirty-six semester hours of acceptable graduate credit is required. The student is expected to take at least twenty-one semester hours within the Civil and Environmental Engineering Department including no more than three semester hours of the appropriate 592 course to be devoted to the preparation of a research paper. In addition, each candidate is required to pass a written comprehensive examination.

Each student will select a minimum of three engineering graduate faculty members to serve as a graduate committee, subject to the approval of the chair of the Civil and Environmental Engineering Department. The committee will:

1. approve the student's program of study;
2. approve the student's research paper topic;
3. approve the completed research paper; and
4. administer and approve the written comprehensive examination.

Teaching or research assistantships and fellowships are available for qualified applicants. Additional information about the program, courses, assistantships, and fellowships may be obtained from the College of Engineering or the Department of Civil and Environmental Engineering.

Courses (CE)

410-3 Solid Waste Engineering. Engineering aspects of solid waste prevention, treatment, recycling and disposal. Design of recycling programs, solid waste treatment and disposal facilities. State and federal regulations. Problems, source, and effects of solid waste. Design projects required. Prerequisite: 310.

412-3 Contaminant Flow, Transport and Remediation in Porous Media. Theory of mass transport and flow in the saturated and vadose zones; stochastic transport theory; retardation and attenuation of dissolved solutes; flow of nonaqueous phase liquids; groundwater remediation. Prerequisite: 310 and 320.

413-3 Collection Systems Design. Design of wastewater and storm water collection systems including installation of buried pipes. Determination of design loads and flows, system layout and pipe size. Prerequisite: 310 and 370a.

415-3 Wastewater Treatment. A study of the design equations used in physical, chemical and biological treatment processes and comparison to design by state standards. Basics of bacteria and their metabolic processes in the degradation of organic wastes. Treatment and disposal of sludges produced in wastewater treatment. Advanced wastewater treatment processes and reuses of wastewater. Prerequisite: 370 and Engineering 351.

418-3 Water and Wastewater Treatment. A study of the theory and design of water and wastewater treatment systems, including physical, chemical, and biological processes. Topics include sedimentation, biological treatment, hardness removal, filtration, chlorination and residuals management. Prerequisite: 310, 370 and Engineering 351.

419-3 Advanced Water and Wastewater Treatment. Advanced concepts in the analysis and design of water and wastewater treatment plants. Topics include advanced physical, chemical and biological processes. Emphasis is on the treatment and disposal of sludges, design of facilities, advanced treatment principles, and toxics removal. Prerequisite: 418.

421-3 Foundation Design. Application of soil mechanics to the design of the foundations of structures; bearing capacity and settlement analysis; design of shallow footings; stability of earth slopes; design of retaining walls, design of pile foundations, coffer dams. Prerequisite: 320.

422-3 Environmental Geotechnology. Geotechnical aspects of land disposal of solid waste and remediation, solute transport in saturated soils, waste characterization and soil-waste interaction, engineering properties of municipal wastes, construction quality control of liners, slope stability and settlement considerations, use of geosynthetics and geotextiles, cap design, gas generation, migration and management. Prerequisite: 310 and 320.

423-3 Geotechnical Engineering in Professional Practice. Application of principles of geotechnical engineering in a real-world setting; planning, managing, and executing geotechnical projects; developing proposals and geotechnical project reports; interpreting and using recommendations developed by geotechnical engineers; total quality management, professional liability and risk management. Prerequisiite: 320, 421 or concurrent enrollment, or consent of instructor.

431-3 Pavement Design. Design of highway and airport systems: subgrades, subbases, and bases; soil stabilization; stresses in pavements; design of flexible and rigid pavements; cost analysis and pavement selection; and pavement evaluation and rehabilitation. Prerequisite: 320 and 330.

440-3 Statically Indeterminate Structures. Analysis of trusses, beams, and frames. Approximate methods. Method of consistent deformations. Three-moment theorem. Slope deflection. Moment distribution. Column analogy. Plastic analysis. Matrix methods. Prerequisite: 340.

441-3 Matrix Methods of Structural Analysis. Flexibility method and stiffness method applied to framed structures. Introduction to finite elements. Prerequisite: 340.

442-3 Structural Steel Design. An introduction to structural steel design with emphasis on buildings. Design of structural members and typical welded and bolted connections using Load and Resistance Factor Design (LRFD) methods. Design project and report required. Prerequisite: 340.

444-3 Reinforced Concrete Design. Behavior and strength design of reinforced concrete beams, slabs, compression members and footings. Prerequisite: 340.

445-3 Reinforced Masonry Design. Materials. Loads. Walls. Columns and pilasters. Beams. Lateral-load resisting elements. Connections and joints. High-rise structures. Environmental features. Quality control. Design project and report required. Prerequisite: 444.
446-3 Prestressed Concrete Design. Fundamental concepts of analysis and design. Materials. Flexure, shear, and torsions. Deflections. Prestress losses. Composite beams. Indeterminate structures. Slabs. Bridges. Prerequisite: 444.
447-3 Seismic Design of Structures. Basic seismology, earthquake characteristics and effects of earthquakes on structures, vibration and diaphragm theories, seismic provisions of the Uniform Building Code, general structural design and seismic resistant concrete and steel structures. Prerequisite: 442 and 444 or consent of instructor.
471-3 Modeling Ground Water Flow and Pollution. Mathematical and numerical models for the analysis of groundwater flow and the transport of pollution by moving groundwater. Finite difference and finite element methods. Transport by advection and dispersion. Application to the design of production wells and remediation of polluted areas. Prerequisite: 413 or consent of instructor.
472-3 Intermediate Fluid Mechanics. A detailed derivation of the Navier-Stokes equations is presented. A working knowledge of these equations is obtained by analyzing several potential flows and some simple viscous flows. Next, the Reynolds' equations are derived followed by an introduction to turbulence. Introducing the concepts of diffusion and dispersion covers contaminant transport. Finally, the foundations of computational fluid dynamics are presented culminating in the numerical solution of several simple viscous flows. Prerequisite: Engineering 370 and Mathematics 305.
473-3 Hydrologic Analysis and Design. Hydrological cycle, stream-flow analysis, hydrographs generations, frequency analysis, flood routing, watershed analysis, urban hydrology, flood plain analysis. Application of hydrology to the design of small dams, spillways, drainage systems. Prerequisite: 370.
474-3 Hydraulic Engineering Design. Hydrostatics, flow in pipes, open channels and porous media metering devices. Includes two to three week projects involving identification, modeling, analysis and design of hydraulic engineering systems. Prerequisite: 370 and Engineering 351.
500-1 to 4 Seminar. Collective and/or individual study of selected issues and problems relating to various areas of civil engineering. Prerequisite: graduate standing.
510-3 Hazardous Waste Engineering. Analysis of hazardous waste generation, storage, shipping, treatment, and disposal. Source reduction methods. Government regulations. Remedial action. Prerequisite: 418 and Engineering 300.
512-3 Aqueous System Analysis. Applied environmental chemistry as it relates to the natural environment and engineered treatment systems. Topics include thermodynamics and kinetics, acid-base equilibria, computer modeling of aqueous systems, the carbonate system, precipitation and dissolution, coordination chemistry and oxidation-reduction reactions. Prerequisite: 310, 418.
516-3 Water Quality Modeling. Water quality factors and control methods. Technical, economic, social and legal aspects concerned with implementation of various engineered systems for water quality management. Case studies. Prerequisite: 418.
517-3 Industrial Waste Treatment. Theories and methods of treating industrial wastes. Case studies of major industrial waste problems and their solutions. Prerequisite: 418.
518-3 Advanced Biological Treatment Processes. The biochemical and microbial aspects of converting substrate to bacterial cell mass or products and its use in various phases of industry (both fermentation and wastewater treatment). Design of activated sludge and trickling filter plants from lab data obtained on explicit wastes from both industry and municipalities. Prerequisite: 418.
520-3 Advanced Soil Mechanics. Advanced theories of soil mechanics, stress distribution in soils, seepage, consolidation, shear strength, settlement analysis and stability of slopes. Prerequisite: 320, 350, 421 or concurrent enrollment.
521-3 Soil Improvement. Methods of soil stabilization, compaction, dynamic compaction, chemical treatment, compaction piling, stone columns, dewatering, soil reinforcement with stirrups, geomembranes and geogrids, ground freezing, stabilization of industrial wastes. Prerequisite: 320, 421.
522-3 Advanced Foundation Engineering. Case histories of foundation failure, bearing capacity theories, shallow foundations, deep foundations, piles under vertical and horizontal loads, pier foundations, foundations for difficult soil conditions, soil improvement. Prerequisite: 421.
523-3 Soil Dynamics. Problems in dynamic loading of soils, dynamic soil properties, liquefaction, dynamic earth pressure, foundations for earthquake and other dynamic loads. Prerequisite: 320 and 421.
540-3 Structural Dynamics. Analysis of the dynamic response of multidegree-of-freedom framed structures. Structural idealizations. Matrix formulation. Lagrange's equations. Response calculation by modesuperposition and direct integration methods. Analysis for earthquakes. Prerequisite: 340 or consent of instructor.
542-3 Nonlinear Structural Analysis. Analysis of the nonlinear response of framed structures subjected to static and dynamic loads. Structural idealizations. Response calculation by incremental and iterative techniques. Instability phenomena of snap-through and bifurcation. Post-buckling behavior. Approximate formulations. Detection of instability under dynamic loads. Prerequisite: 441 or 551 or consent of instructor.
544-3 Advanced Design of Reinforced Concrete. Deep beams, shear friction. Slab, beam, girder systems. Monolithic joints. Retaining walls. Deflections. Length effects on columns. Two-way floor systems. Yield line theory. Torsion. Seismic design. Prerequisite: 444.

545-3 Advanced Steel Design. Economical use of high strength steel; behavior and design bolted and welded building connections, plate girders and composite steel-concrete beams; brittle fracture and fatigue; and low-rise and industrial-type buildings. Prerequisite: 442.
551-3 Finite Element Analysis. (Same as Mechanical Engineering 565). Finite element analysis as a stress analysis or structural analysis tool. Derivation of element stiffness matrices by various means. Application to trusses, plane stress/strain and 3-D problems. Dynamic and material nonlinearity problems. Prerequisite: Civil Engineering 350 and Mathematics 305.
552-3 Theory of Elasticity. Stress and strain and equations of elasticity; equilibrium equations; compatibility equations; stress functions; applications of elasticity in solving engineering problems in two- and three-dimensions. Prerequisite: 350 and Mathematics 305.
553-3 Theory of Plasticity. (Same as Mechanical Engineering 513) Criteria for onset of yielding, isotropic and kinematic strain hardening; flow rules for plastic strains; elastic plastic bending and torsion, slip line field theory; plane stress problems; limit analysis. Prerequisite: 350 and Mathematics 305 or consent of instructor.
554-3 Experimental Mechanics. An introduction of various experimental techniques that are commonly used to determine properties such as deformation, straining, surface contour, etc. The topics to be covered include the principles of strain gage technology, theory of photoelasticity, piezoelectric accelerometer, laser based interferometry, image processing and analysis, and reverse mechanics. The specific areas of practical application of each experimentation will be discussed. Prerequisite: 350.
556-3 Theory of Laminate Composite Structures. Orthotropic and Anisotropic Materials, Laminated Plate Theory, Ritz Method, Galerkin's Method, bending, buckling and vibration of laminated structures. Prerequisite: 350 and Mathematics 215.
557-3 Advanced Mechanics of Materials. (Same as Mechanical Engineering 566). Advanced topics in mechanics of materials including: elasticity equations; torsion of non-circular sections; generalized bending including curved beams and elastic foundations; shear centers; failure criteria including yielding, fracture and fatigue; axisymmetric problems including both thick and thin walled bodies; contact stresses; and stress concentration. Prerequisite: 350 and Engineering 222.
570-3 Sedimentation Engineering. Introduction to the transport of granular sediment by moving fluids; analysis of regional degradation, aggradation and local scour in alluvial channels; investigation of sediment sources, yield and control. Prerequisite: 474 or consent of instructor.
571-3 Water Resources Systems Engineering and Management. Philosophy of water resources planning; economic, social and engineering interactions related to water quantity; quantitative optimal planning methodologies for the design and operation of hydrosystems; guest lecturers; projects/case studies. Prerequisite: 474 or consent of instructor.
572-3 Advanced Hydraulic Design. Design and analysis of stormwater control and conveyance systems, dams, spillways, outlet works, stilling basins, culverts and other complex hydraulic systems. Prerequisite: 474 or consent of instructor.
573-3 Modeling of Hydrosystems. Hydraulic and hydrologic modeling; theory and application of common surface and subsurface flow models such as HEC–RAS, HEC–6, FLDWAV, DAMBRK, MODFLOW and MODPATH. Prerequisite: 474 or consent of instructor.
592-1 to 5 Special Investigations in Civil Engineering. Advanced Civil Engineering Topics and/or problems in **(a)** Structural Engineering, **(b)** Hydraulic Engineering, **(c)** Environmental Engineering, **(d)** Geotechnical Engineering, **(e)** Fluid Flow Analysis, **(f)** Computational Mechanics, **(g)** Composite Materials, and **(h)** Stress Analysis. Prerequisite: graduate standing and consent of instructor.
599-1 to 6 Thesis.
601-1 per semester Continuing Enrollment. For those graduate students who have not finished their degree programs and who are in the process of working on their dissertation, thesis, or research paper. The student must have completed a minimum of 24 hours of dissertation research, or the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded *S/U* or *DEF* only.